The Gre
KIT
Bo

Norman Sch

The Great Kite Book

Norman Schmidt

Sterling Publishing Co., Inc. New York
A Sterling/Tamos Book

ıg / Tamos Book
Norman Schmidt

Publishing Company, Inc.
k Avenue South, New York, NY 10016

Books Inc.
les Avenue, Winnipeg, MB, Canada R2M 2S9

8 7 6 5 4 3 2

ıted in Canada by Sterling Publishing Co., Inc.
ıadian Manda Group, 1 Atlantic Avenue, Suite 105
, Ontario, Canada M6K 3E7
ıted in Great Britain and Europe by Cassell PLC
ton House, 125 Strand, London WC2R 0BB, England
ıted in Australia by Capricorn Link (Australia) Pty Ltd.
: 6651, Baulkham Hills,
s Centre, NSW 2153, Australia

Norman Schmidt
hy Jerry Grajewski, Custom Images
n of historical kites Stefan Czernecki

'actured in United States of America
hts reserved

IAN CATALOGING IN PUBLICATION DATA

t, Norman Jacob, 1947-

at kite book

ling/Tamos book."
s index.
-895569-36-2 (bound) – ISBN 1-895569-17-6 (pbk.)

– Design and construction. I. Title.

S35 1996 629.133'32 C96-920147-8

Y OF CONGRESS
OGING IN PUBLICATION DATA

lt, Norman.
reat kite book / Norman Schmidt.
p. cm.
erling/Tamos book."
des index.
1-895569-36-2
tes I. Title.
9.S35 1997
133'32 — dc21 96-37195
CIP

SBN 1-895569-36-2
BN 1-895569-17-6

DUDLEY PUBLIC LIBRARIES
L 43131
89506 SCH
J 796.15

Metric measurements have been calculated by multiplying inches by 2.5 and rounding off centimeters.

The advice and directions given in this book have been carefully checked, prior to printing, by the Author as well as the Publisher. Nevertheless, no guarantee can be given as to project outcome due to possible differences in materials and construction and the Author and Publisher will not be responsible for the results.

Contents

Kites are universal 3
Kite basics 4
About the kites in this book 10
Instructions 12
1 Plain Kite 20
From mythical origins
to high technology 23
2 Red Admiral 24
3 Bat 28
4 Bumble Bee 32
5 Barn Swallow 36
6 Monarch 40
7 Dragonfly 44
8 Seagull 48
9 Mourning Cloak 52
10 Firefly 56
11 Falcon 60
12 Buckeye 64
13 Peacock 68
14 Tiger Swallowtail 72
15 Ladybird 76
16 Eagle 80
17 Zebra 84
18 Canada Goose 88
19 Albatross 92
Glossary 95
Bibliography 95
Index 96

Kites are universal

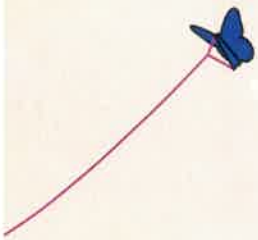
Who flew the first kites? It is not known for certain. Probably were invented quite independently in different parts of the w first appear in the folklore and ancient writings of oriental cu Simple kites consisting of little more than a large tropical leaf used for fishing, were common in the South Sea islands. On t Chinese mainland people built and elaborately decorated mo ticated kites that were flown for military and ceremonial purp

Although kites were known in early western society and also had ceremonial and military significance, they were even regarded as useless objects. Kites in the west gained no religi importance, and increasing urbanization and industrializatio vented the gentle art of kiting from becoming popular. Only the brief time of experimentation with flight that preceded t tion of the airplane, when kites fired the western imaginatio visions of human flight, did kiting become significant. Once were a reality, however, the popularity of kiting waned. Conse many individuals have never experienced the pleasures of ho building these simple airborne wonders. And many people in cultures still consider kiting an idle waste of time — hence, " kite," has become a derogatory expression. Other people feel dated by kiting, thinking that it is too complicated for them, are afraid their kites won't fly because they have no experien such airborne things.

But times are changing. Industry and technology have no altogether bad for kite making. They have yielded materials th ideally suited to this art, and kite enthusiasts are taking advan them to create new styles and types having increased maneuv This has allowed kite flying to be organized into competitive and kiting has become a sport, making kites more visible in r communities around the world. Consequently more people f inclined to give kiting a try, and kite flying for fun is gaining larity once again.

While people fly kites for different reasons, nothing quit the satisfaction of getting a kite of one's own research and cr airborne. This is the essence of the art of kiting. It connects th flier with the past and gives a sense of participating in someth historically significant, knowing that countless numbers of p around the world have engaged in this distinguished activity immemorial. Kiting provides mind-soothing satisfaction whe fragile creature, hovering, swooping, swaying back and forth, paints the canvas of sky overhead. And a sky full of kites is tr inspiration to the human spirit.

ite basics



eased from the ground flies upward
arc created by its tether.

SCALE

7 mph (1-11 km/hr)
d can just be felt on one's face,
e in motion, and smoke drifts.

8-12 mph (12-20 km/hr)
able breeze. Leaves rustle, small
ove, and flags flutter.

e: 13-20 mph (21-30 km/hr)
day. Dust is picked up, flags flap, and
anches move.

ver 20 mph (30 km/hr)
rtably windy. Small trees sway
ly and debris flies about.

adow — Air passing over obstacles
ent on the downwind side for a
of about seven times the height of
cts.

Wind

Kites are creatures of the wind. And as there are many kinds of wind, there are many kinds of kites to suit them. It is the sky and the wind, stirring the human imagination, that gave rise to kites in the first place, and it is the wind that determines what kind of kite to fly on any given day. Considering the variables possible in a kite (aspect ratio, lift-to-drag ratio, stability, and angle of attack), flying kites becomes a balancing act in every sense. And learning to "read the wind" is as important to successful kite flying as understanding the principles of flight. Not all kites fly in any kind of wind. On a blustery day, when many people think it must be "good kite weather," chances are the wind is suited only for box kites and aerobatic kites that can tolerate high wind speeds. **Most kites fly in gentle winds with speeds between 8 and 12 miles per hour (12-20 km/hr), when leaves on trees rustle.**

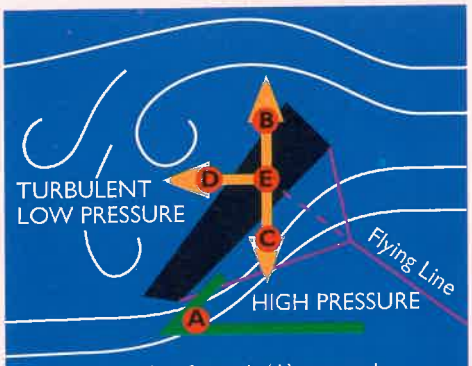
Wind speed also increases with altitude. This is known as the wind gradient. Wind near the ground is slowed by the friction caused by passing over the ground. One might observe the surroundings and think the wind is gentle, but at 1,000 feet (300 m) it might well be strong. Wind gradients can vary considerably. Therefore, even though a kite may not fly at ground level, once at altitude it will fly happily.

Near the ground wind also tends to be turbulent, caused by passing over trees, buildings, and other objects. Besides creating impossible wind conditions, areas with obstacles often present real hazards, such as traffic or overhead wires. Wide open areas are best for kite flying. If obstacles are present, consideration must be given to their "wind shadow," an area of extreme turbulence immediately downwind of an object. **"Wind shadows" cover a distance of at least seven times an object's height.** For example, a 20 foot (6 m) tree has a wind shadow of 140 feet (42 m).

Kite performance

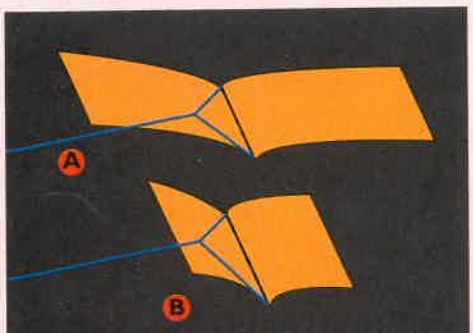
A kite is fundamentally like an airplane on a tether; both fly according to the same aerodynamic principles. Both are heavier than air and must incorporate some means of overcoming the effects of gravity by an upward force utilizing the air flowing across their surfaces. Both must also have a way of remaining stable when airborne.

Three main forces — gravity, lift, and drag — are at work on a kite when in flight. An airplane has a fourth, thrust, to propel it through the air, making its own "wind."



With the angle of attack (A) correctly adjusted, the forces of lift (B), gravity (C), and drag (D), coincide with the angle of the flying line at the center of pressure (E).

When an airplane moves forward (creating "wind"), lift is produced because the airfoil (wing) has a curved upper surface, and is set at an angle to the airflow (angle of attack). In flight, air that flows over it has reduced pressure because the molecules spread apart as they travel around the curve (a greater distance than the straight lower surface). The air beneath has increased pressure because the molecules are pressed together by striking the lower surface.



Aspect ratio — A square kite has an aspect ratio of one. The greater the span from wingtip to wingtip the higher the aspect ratio, and the more efficient but less stable the kite.

A kite, like every object, has a center of gravity, the point all weight appears concentrated and at which it balances. Like can be said to have a center of lift, the point at which all air p against the kite is concentrated, and a center of drag, the poir kite where all resistant forces are concentrated. In a well bala these forces coincide at a single point, the center of pressure, the flying line is attached.

Performance and the angle of attack The covering of a kite is its win ing sail. An upward force is created as wind strikes the sail to zone of increased air pressure on its face (facing the person f and a zone of decreased pressure on its backside. To achieve t kite is set at an angle to the wind so that its leading edge (top higher than the tail end, allowing the wind to strike the face angle, exerting pressure on it. The sloping of the sail is called angle of attack. Air is deflected downward, resulting in an op upward force being produced — lift. The upward force oppo force of gravity, making the kite rise into the air.

Not only does air strike the face, but it spills over and are kite to the backside creating a partial vacuum on the backsid thing like a cambered wing (curved airfoil) of an airplane. Th ered pressure sucks the kite upward, adding to the lifting for

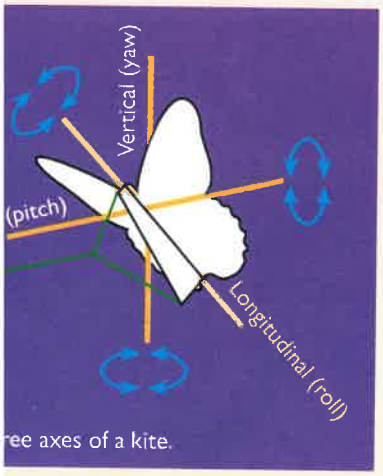
A kite's angle of attack can be much greater than that of as found in an airplane wing because of a kite's light weight. tolerate to be stalled while an airfoil can't. And the air on the is more turbulent and separated more from the sail than air airfoil. But every kite has an optimum angle of attack, relativ given wind speed, when the three forces coincide.

Performance and shape Every kite has a relationship of width (spa length (chord). This is the aspect ratio. A square kite has an a of one. A kite that is wider than it is long has a higher aspect the higher the aspect ratio is, the more efficient and buoyant becomes, but the kite becomes less stable in the air. On the o a kite with a low aspect ratio is more stable, but less efficient

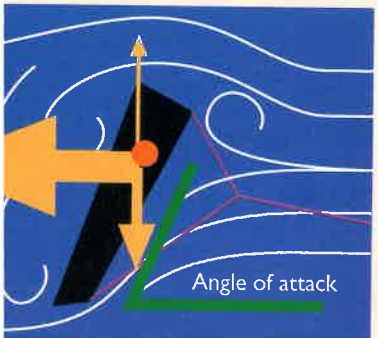
Performance and efficiency Not all kites climb as high as others. Al production has a corresponding penalty of drag because win a kite produces turbulence and friction (induced drag). Any producing parts of a kite (such as decorations and streamers that are not producing lift add to the overall drag, decreasing efficiency (parasite drag). Therefore every kite, regardless of has a lift-to-drag ratio, which may be high or low. If a well a kite has a high lift-to-drag ratio, that is, if it is well streamlin climb high along the arc. A kite having a low lift-to-drag rati when well adjusted, will not climb high along its arc.

Kite stability

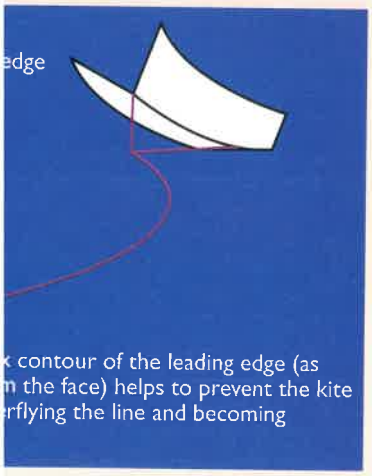
All kites, regardless of their aspect ratio and efficiency, are relatively unstable and must have a means of stabilizing their flight. A kite tends to roll along its longitudinal axis; yaw along its vertical axis; and pitch along its lateral axis. To counteract, three-axes stability is needed. There are several things that contribute to stability, either by being built into the airframe or added to it. They are, adjusting the angle of attack, giving the kite a dihedral angle, a convex leading edge, a keel, and the addition of a long tail. The most common means of attaining any kind of stability is the addition of a tail. A tail contributes especially to yaw and pitch stability. With the correct angle of attack, even a flat kite can be given enough stability to become airborne with only a tail added. In some kites, strategically placed vents in the sail are yet another means of adding stability. **Most importantly, stabilizers can be used in any combination to maximize their effectiveness.**



ree axes of a kite.



ne angle of attack is too great,
ce increases, drag is much stronger,
s diminished. The kite becomes



edge

k contour of the leading edge (as
n the face) helps to prevent the kite
rflying the line and becoming

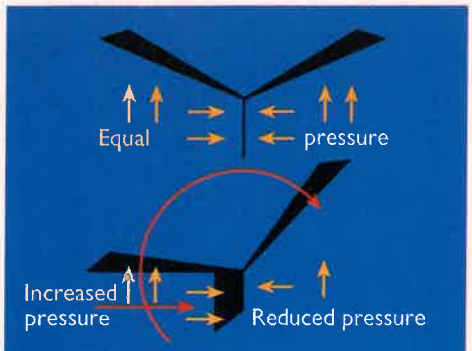
Stability and the angle of attack Striking a balance between finding the optimum angle of attack and adjusting the stabilizing devices is not always easy because of the interdependency between a kite's shape, its inherent performance, and its degree of instability, compounded by variations in wind speed.

There is no single overall best angle of attack. Every kite ideally needs to have a different angle of attack for every change in wind speed. If the wind speed increases two things occur. First, the kite begins to slide down its arc because the drag increases, and the angle of attack becomes larger. Second, the kite becomes unstable because the air pressure and accompanying turbulence are so great that they exceed the stabilizer's ability to compensate. Then the kite goes into very tight lateral spins. **If a crash is imminent, to minimize damage, always give a kite plenty of slack line.**

The first remedy is to reduce the angle of attack, allowing more air to spill around the kite, decreasing drag, and allowing the stabilizing system to work. The second is to increase the effectiveness of the stabilizing system itself by adjusting it for the conditions.

Unless some method of making airborne adjustments to the angle of attack or the stabilizer is built in, the best one can do is optimize them for any given flight. **The rule is — low wind speed, high angle of attack; high wind speed, low angle of attack.** Keeping a kite airborne in variable winds is a matter of working the line, increasing and decreasing tension on the line.

Stability and leading-edge contour Sometimes a kite's leading-edge contour causes pitch instability, making a kite climb so that it overflies the line. At low altitudes this can have disastrous results. This kind of pitch instability can be lessened if the leading edge is convex (as seen from the face). This must be built into the airframe of the kite.



When a kite having a dihedral angle and a keel is upset by a gust, the pressure increases on the lowered and yawed side. The unequal pressure rights the kite, restoring eqilibrium.

Kites can be stabilized with a variety of tails. Besides their practical purpose, they add decoration.

Stability and the dihedral angle A dihedral angle is the upward slanti the outer tips of the sail away from the spine. This can be buil the airframe by bowing the spars or fixing the spars at an ang kite then has a natural tendency to right itself when upset. Su an airborne kite (that has dihedral) dips one wingtip downw larger area is exposed to the wind on that side, increasing lift, ing the kite, and restoring equilibrium. This is roll stability.

Stability and a keel An effective way of attaining yaw stability is b giving the kite a keel (a vertical surface). Stability occurs beca airstream flowing past the vertical plane exerts equal pressure both sides, keeping the kite facing into the wind.

A keel can be built into the airframe. Another kind of keel formed by filling in (with a material similar to the sail) the tr made by a normal two-legged bridle.

Sometimes a keel is all that is needed to attain stability ov wide range of wind speeds. If the keel is not sufficiently large, kite may be stable at lower wind speeds but not when the win speed increases. Then the addition of a short tail would solve t problem. If the keel is too large the keel will decrease stability because it catches every stray gust of wind, blowing the kite b forth in the sky.

Stability and a tail By creating drag behind the kite, a tail offsets tendency for dynamic forces acting on the sail (yaw and pitch upset the kite. As the tail sways back and forth, it pulls gently kite's spine in the opposite direction. If the tail is of correct le this back and forth motion is in direct proportion to the upset tendency, neutralizing it. If the tail is too long, it will not sway and forth rhythmically, thereby not stabilizing effectively. And will decrease the overall efficiency of the kite. If the tail is too it will be unable to compensate the upsetting tendency of the and it will remain unstable in the air.

A tail may consist of a single plain ribbon, a ribbon with a of tabs attached, a number of ribbons, a large number of ribb make a donkey tail, or a series of bows on a string.

As a general rule, for a kite that is primarily dependent on for stability, the tail should be about seven times the length of spine. But its length must be adjusted according to the wind s **The stronger the wind, the longer the tail must be.**

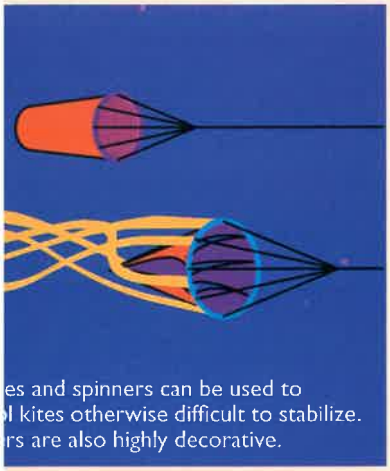
Besides the practical nature of a tail, it also serves as decor adding beauty to a kite as it sways back and forth.

Stability and a drogue Sometimes a kite climbs so rapidly, either b it is very buoyant or the wind decreases, that it overflies the li rising along its arc past the zenith. This greatly reduces the ang

attack, allowing the line to go slack, and the kite goes into a series of large lateral loops. If this cannot be corrected by changing the angle of attack or lengthening the tail, adding a drogue may help.

A drogue is simply a short conical fabric tube with the large end facing into the wind, something like a short windsock or narrow parachute. A shroud fastens it to a line, which is then attached to the kite. Unlike a tail, a drogue does not create drag along its length, but concentrates it within the cone. The result is not compensatory undulation in the airstream, but a lever effect. A drogue pulls its line taut, and the longer the line the greater the stabilizing effect.

A variation on the drogue is the more decorative spinner. The spinner's cone consists of a number of fabric triangles collected at a central point. Instead of air escaping from a single small opening at the end, it escapes between the triangles, setting the device spinning. When a number of ribbons are attached, it becomes quite a spectacle in the air.

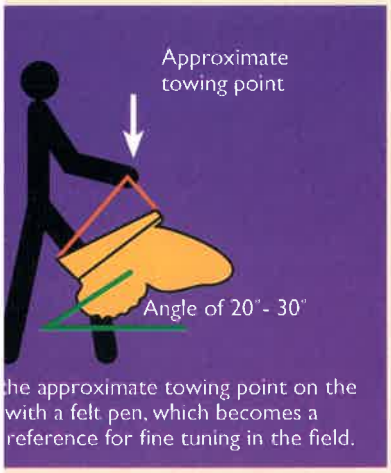


es and spinners can be used to
l kites otherwise difficult to stabilize.
rs are also highly decorative.

Bridling a kite

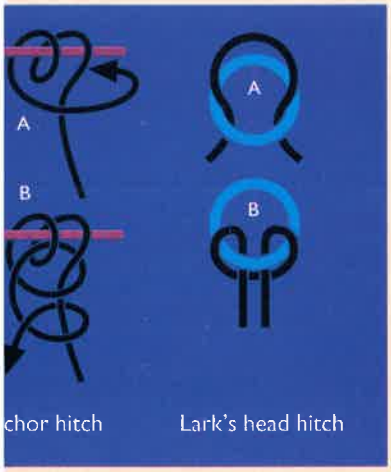
The bridle is the loop of string attached to the kite's spine, running front to back. A good knot to use for this is an anchor hitch. To the bridle is attached the flying line (tether) at a location called the towing point, dividing the bridle into two legs. The positioning of the towing point is very important because it determines the angle of attack that a kite can assume relative to the flying line. Moving the towing point changes the angle of attack. The correct positioning of the towing point on the bridle is important if the maximum performance of a kite is to be realized. If the towing point is in the wrong place, even the best of kites will not get airborne successfully.

There is no hard and fast rule about how long the loop of the bridle line should be. **Generally, the bridle should be of sufficient length so that the towing point is away from the spine by a distance of at least half a spine length.**



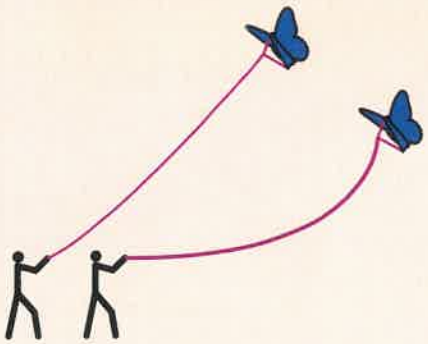
he approximate towing point on the
with a felt pen, which becomes a
reference for fine tuning in the field.

The approximate place along the bridle at which the towing point will fall can be ascertained quite easily before a kite is flown, but the precise point can only be determined in the field. Lay the kite on its back and, draping the bridle loop over one finger, lift the kite slightly off the ground. By sliding the string, slant the kite so that the tail end of the spine touches the ground and the front is raised. The angle thus formed between the spine and the ground should be between 20° and 30°. The point at which the string then drapes over the finger is the approximate towing point. Mark this point using a felt pen and attach a towing ring to the bridle line at this point, using a lark's head hitch.

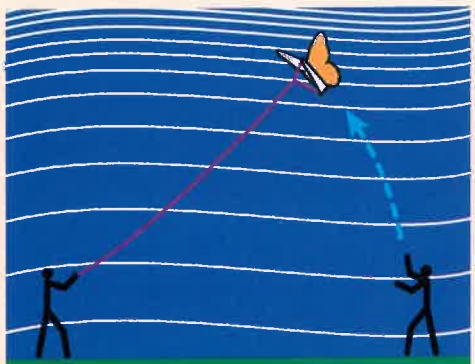


chor hitch Lark's head hitch

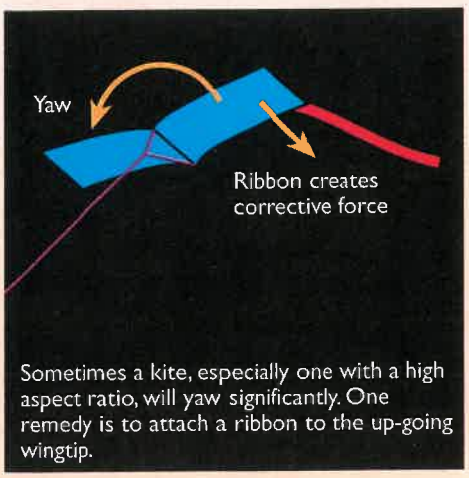
Fine tuning the towing point must be done relative to the wind speed at any given time. **To increase the angle of attack, move the towing ring toward the tail end of the bridle line. To decrease the angle of attack, move it forward.**



The kite on the left has a thin smooth line. The one on the right has a heavy coarse line. Although the kites are identical, the heavy line increases drag, making the line sag.



For a high start, the person on the left puts tension on the line as the kite is released and climbs through the wind gradient. If sufficient wind is found, the kite will stay aloft.



Sometimes a kite, especially one with a high aspect ratio, will yaw significantly. One remedy is to attach a ribbon to the up-going wingtip.

There are some kites that need a bridle having more tha two legs. For example, kites with fragile frames, or those wit frames like limp canopy type kites. In the latter the bridle ha many legs that it is called a shroud. Then the bridle serves nc an attachment for the flying line, but also as a support for th receiving sail.

Flying line

The type of flying line used also has a bearing on performan kite gains altitude, and an increasing amount of line is let ou weight the kite must bear increases. Not only the actual weig string is involved, but also the length of line: as it increases, the drag of the wind striking the line. At a certain point the k longer able to climb, the line just sags more. To minimize thi use the lightest, thinnest, and smoothest line that a kite in ar particular wind can use without breaking the string.

Launching kites

Given that all adjustments of bridle and stabilizers have been anced and conditions are perfect, a kite presented to the win fly directly from one's hand, rising skyward effortlessly alon moving back and forth gently in the currents of air. If there i quite enough wind near the ground, pumping the line as it through the wind gradient may help, until the kite reaches s wind higher up.

Alternately a "high start" can be tried. This requires two One person holds the line and another the kite. Line is let ou person walks downwind with the kite to a distance of at leas feet (30 m), perhaps more. With the line taut, the kite is rele kite operator immediately applies additional pressure to the reeling it in, pumping the line, walking backwards, or some nation of these. However, a close watch must be kept on the just the right amount of pressure applied. (Running with a k a good idea, because not enough attention can be paid to th behavior.)

It is essential that the stabilizing system used is given a c take immediate effect, otherwise an upset will occur. Therefo should not be held bunched up, but allowed to fly freely fro ground up. And not too much pressure should be exerted on by the operator.

When the kite achieves some altitude and a sufficiently s wind is found, the high start is successful if the kite maintai altitude. But if no stronger wind is found aloft the kite will s back down to the ground. The operator should give it free li descends. Another high start can then be tried, using a longe gain more altitude.

bout the kites in this book

Ever since the first kites were built materials and methods have been changing. In the Orient these changes were realized in a slow evolution of styles unique to various locations. These styles became established as traditions that were passed down from generation to generation. Kite art became highly refined, practiced by master craftsmen.

Traditional oriental kites utilize a semi-rigid frame made from bamboo, wood, and string, covered with paper or fabric bearing colorful images. The westernization of kites coincided with increasing technological innovation between the eighteenth and twentieth centuries, immediatley preceding the invention of the airplane. Since there were no traditional biases, new ideas about materials and methods emerged freely. On the one hand innovation led to successful airplanes, and on the other it led to different kinds of kites.

One new twentieth-century material is Tyvek™ (DuPont), made from spunbonded polyethylene. It is made in a sheet form that resembles paper, as well as a softer cloth-like form. The sheet form does not stretch, can be cut without fraying, does not tear easily, and can be sewn, glued, and colored. It is distributed by paper merchants and can be obtained readily from any printing shop.

The kites in this book take advantage of sheet form Tyvek because of its inherent qualities. All the kites follow a similar method of construction which is based on Tyvek's strength and its resistance to stretching. All the kites are constructed with no perimeter frame. The main frame is attached directly to the Tyvek, leaving the entire kite flexible. Building such a "flex-frame" kite requires careful positioning of the frame so that it gives support to the sail in a way that allows the natural pressure of the wind against the sail to give it aerodynamic form. A main spreader strut gives the kite a fixed dihedral angle at the front spars. The rear spars may have a secondary strut. The entire frame flexes, giving shape to the sail, as determined by the wind pressure. A built-in keel gives stability.

The kites have a relatively shallow angle of attack, exerting only a light pressure on the bridle and flying line. A light cotton string is sufficient for both.

Applying this "flex-frame" principle, a wide variety of airworthy kites has been included here, resembling various flying creatures. They can be built using non-specialized tools and techniques simple enough for anyone to master. Once the principle is understood, it can be applied to kites resembling many other creatures or objects,

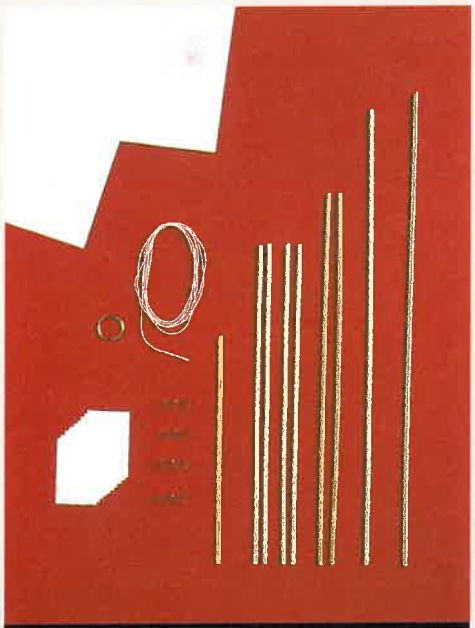
E: Experimentation is
ble with all of the kites. For
ple, you might change the
ral angle by lengthening or
ening the spreader struts.
ou could try building a kite
ut a keel to discover what
this might have. And of
e different tails can always
ed.

limited only by the builder's imagination. It is hoped that th will inspire you to attempt your own creations.*

The following list outlines the things needed to build th this book.

Tyvek ™ (DuPont)

Standard sheet size — 36 in x 30 in (90 cm x 75 cm).
Thickness — .0056 calliper.
Tyvek is distributed by paper merchants and is available from any local printi



Shown above are the materials for one kite (the Bat) – Tyvek sheeting for the sail, dowels cut to size for the frame, fastening tabs cut to size from scrap Tyvek, joiners cut from polyethylene tubing, string for the bridle, and a split ring for the towing ring.

Hardwood dowels

Standard sizes — ranging from 1/8 in (3 mm) diameter to 1/4 in (6 mm).
Hardwood dowels are available at hardware stores or lumberyards.

Flexible polyethylene tubing

Polyethylene tubing is available in various degrees of rigidity tubing is required. Inside diameters must match the dowels - 1/8 in (3 mm) to 1/4 in (6 mm).
Polyethylene tubing is available from hardware stores, automotive parts suppli home wine-making shops.

String, towing rings, and swivel hooks

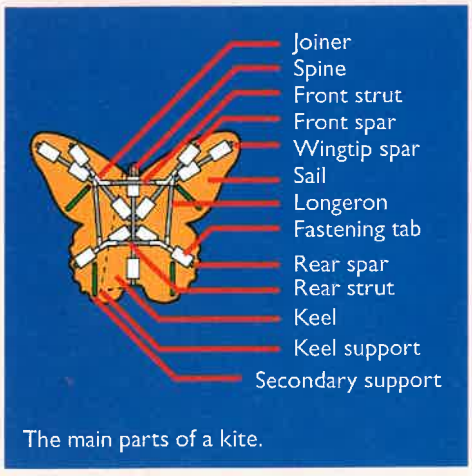
Light cotton string or heavy sewing thread for the bridle and line. Split rings or drink can pull-tabs for towing rings, and f line swivels. A suitable line reel is also needed.

Shop equipment

Shop equipment such as ruler, pencil, craft knife, scissors, m tape, white craft glue (the kind that remains flexible when d small saw, and sandpaper are required for construction.

For decorating Tyvek use transparent acrylics, such as Createx (designed for use in airbrushes). These can also be applied b Giant felt markers can also be used with success. Especially u refillable ones such as Pantone Tria™.

All the kites in this book use similar construction techniques the pattern on a Tyvek sheet, cut out the shape of the kite, ad and fasten the frame to the sheet. (Detailed instructions are g the following pages.)

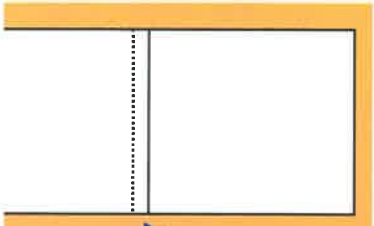


The main parts of a kite.

* See also Ito, Dr. Toshio, and Hirotsugu Komura. *Kites: The Science and the Wond* Publications, Inc., Tokyo, 1983.

nstructions

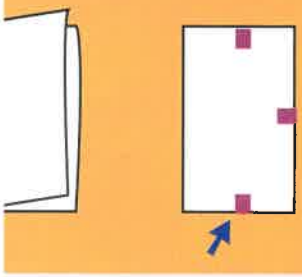
se general instructions can be followed to make all the s in this book



ultiple sheets,
p 1" (2.5 cm)
ue seam.

d in half
l to inside).

Tap
each



To facilitate in copying the outline shape and face pattern from the book, use a transfer grid of 2" (5 cm) squares.

Step 1

Some of the kites require one whole sheet of Tyvek (standard sheet size of 36 in x 30 in – 90 cm x 75 cm), others need only part of a sheet, and some more than one. For kites made from a single sheet, lay sheet flat in a horizontal direction. For large kites requiring more than one sheet, begin by assembling multiple sheets as needed, then proceed as though it were a single sheet. Build the kites on a suitable flat surface.

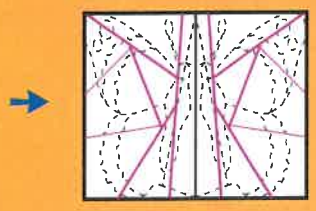
Step 2

Fold sheet in half so that left edge meets right edge. Tape edges so that the folded sheet remains aligned. The outer sides of the folded sheet will become the kite's face. (Note: Tyvek has a natural tendency to curl. Make sure that when the sheet is folded, the curl is toward the inside so that when the kite is finished, the convex side of the curl is on the face.)

Step 3

Using the grid method, transfer the kite's outline shape and its decoration pattern from the book onto the folded Tyvek sheet. This will become the **righthand** side of the kite's face. Take note of the area that will become the kite's keel. (Note: First draw lines lightly in pencil. Then darken using felt marker. Finally, to get the pattern onto the other side of the kite, trace the lines showing through the sheets onto the opposite (**lefthand**) side using a window or a lightbox to aid in seeing the lines.

Lay the kite flat facedown. Measure and draw lines for the keel and frame positions.



Step 4

Remove tape from edges and unfold sheet. Lay sheet flat face
On the backside, measure and draw lines for the keel folds, t
frame positions, and the secondary supports, as shown in the
for each particular kite.

With sheet folded and edges taped, cut out the kite's outline shape.

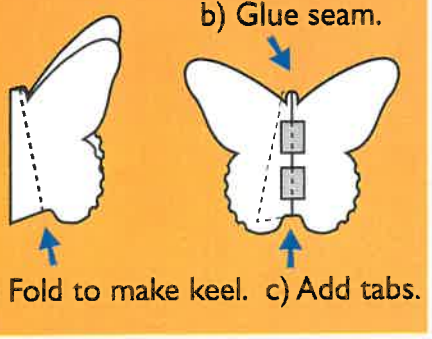
Step 5

Refold and tape edges as before. Using either a craft knife or
scissors, cut out the outline shape of the kite.

Paint the face of the kite.

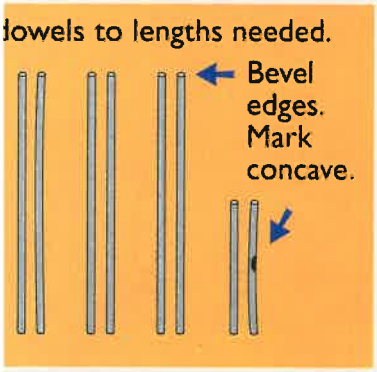
Step 6

Unfold and lay the kite flat faceside up. Add color to the face
sail, either following the color scheme shown or inventing y
own.



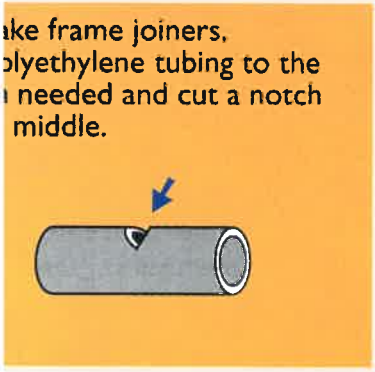
Step 7

Fold along drawn lines (step 4) to make the keel. Glue the se
one reinforcement tab at the point where the front spars mee
seam, and one where the rear spars meet the seam.



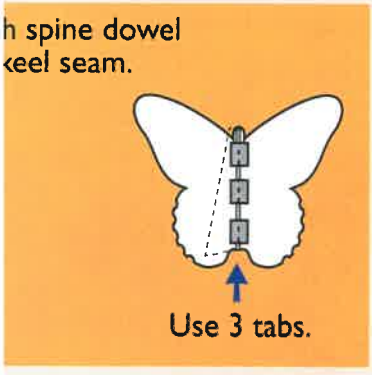
Step 8

With the exception of the longerons, cut all the wood dowel frame pieces to the lengths given for each particular kite. Bevel the edges. (Note: Wood dowels have a natural tendency to bow. Make a mark on the concave side of each of the frame pieces for later reference.)



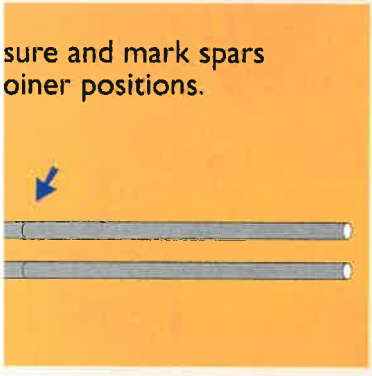
Step 9

Cut polyethylene tubing into short lengths for the frame joiners. Cut a notch in the middle of each piece to complete joiner.



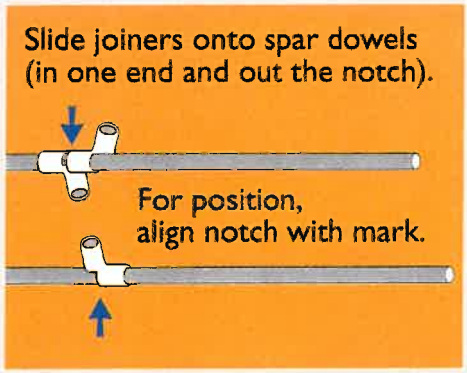
Step 10

Using three tabs, glue the spine into position along the keel seam to the backside of the sail. (Note: When attached, the concave side of the bow should be facing away from the sail.)



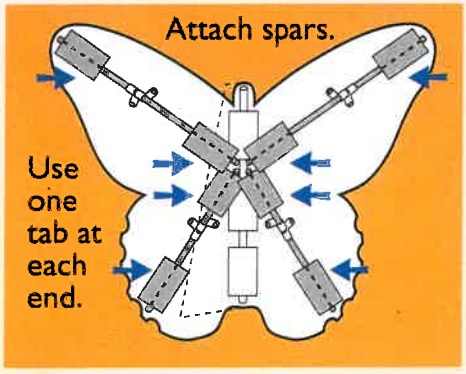
Step 11

On the front and rear spars, measure and mark the positions for the frame joiners. (Note: For easier reference, make the mark as a line drawn completely around the dowel's circumference.)



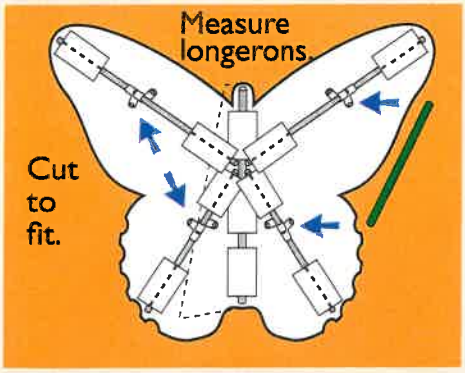
Step 12

Slide the frame joiners onto the front and rear spar dowels to correct positions. For all kites, the front spars need two joiner one for the longerons and one for the spreader strut. For som the rear spars need only one for the longerons. Others require on both the front and rear spars because the kites need a spre strut at both front and rear spars. (See frame layout for each particular kite.)



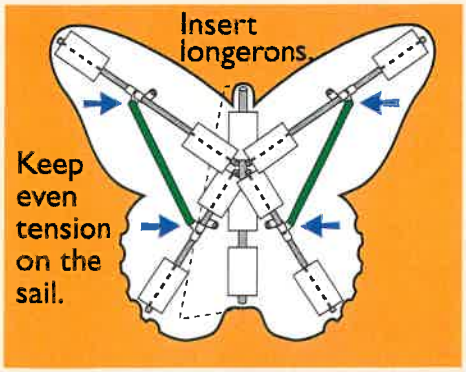
Step 13

Using the lines drawn in step 4 as guides, fasten the front and main spars to the sail using one tab at each end. (Note: When spars are attached to the sail, the concave bowing should be fa away from the sail. Achieving this will require rotating the joi the dowels before attaching them to the sail.)



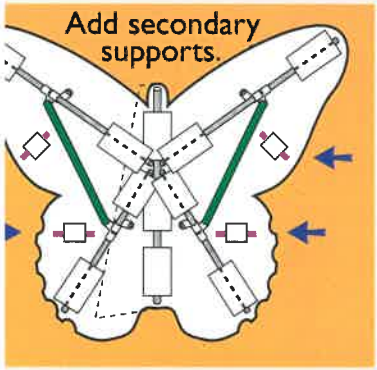
Step 14

Measure between the front and rear spar frame joiners to dete the length of the longerons. Cut the longerons and bevel edge the spars have been attached symmetrically, the lefthand and righthand measurements should be the same.)



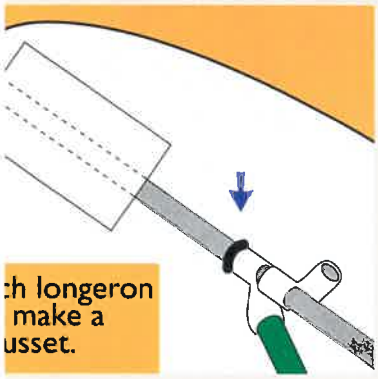
Step 15

Once the glue on the tabs for the spars has set, on each side, s one end of the longeron into the open end of the frame joine the rear spar. Then carefully ease the other end into the joiner front spar. Make sure that there is even tension on the sail.



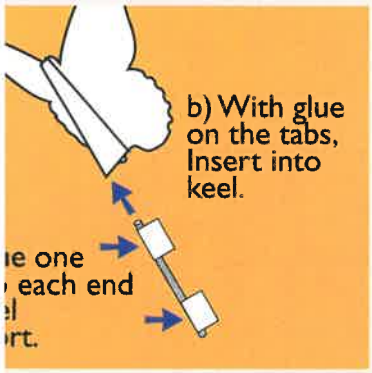
Step 16

Most kites need secondary supports to stiffen the sail. Some kites also require two front spars – main spars and wing spars – on each side (see frame layout for each particular kite). Using the lines drawn in step 4 as guides, fasten the wing spars and secondary supports to the sail.



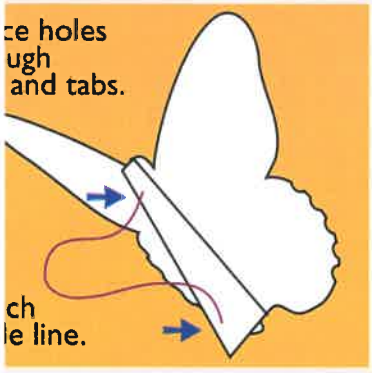
Step 17

Put a small amount of glue at each outside end of the frame joiners, making a gusset of glue to keep the joiners in place. This completes the main frame.



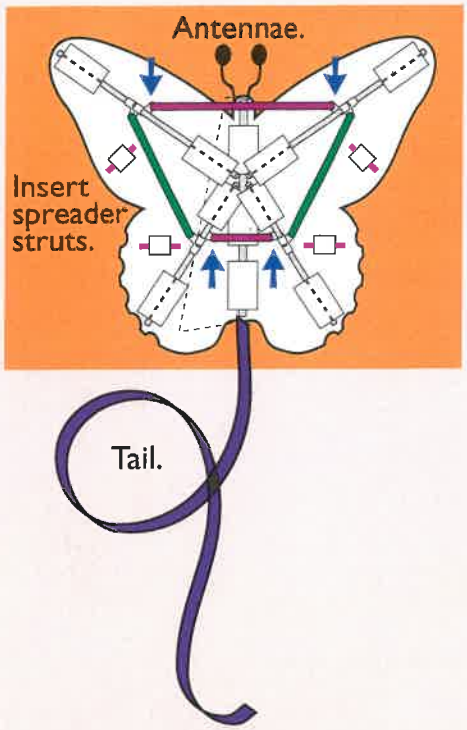
Step 18

Fasten a tab to each end of the keel support dowel. (Also see next step.) The tabs are used to glue the support into the keel and give extra strength for the bridle attachments. With glue on the tabs, slide dowel into the keel and press into place. (Note: When finished, the concave side of the bow should be facing the back.)



Step 19

At each tab, pierce a hole through the keel and the tab. For the exact location of bridle attachments, see the frame layout for each kite. Using these holes as the attachment points for the kite bridle, tie the bridle line to the keel support dowel using an anchor hitch (see p. 8).



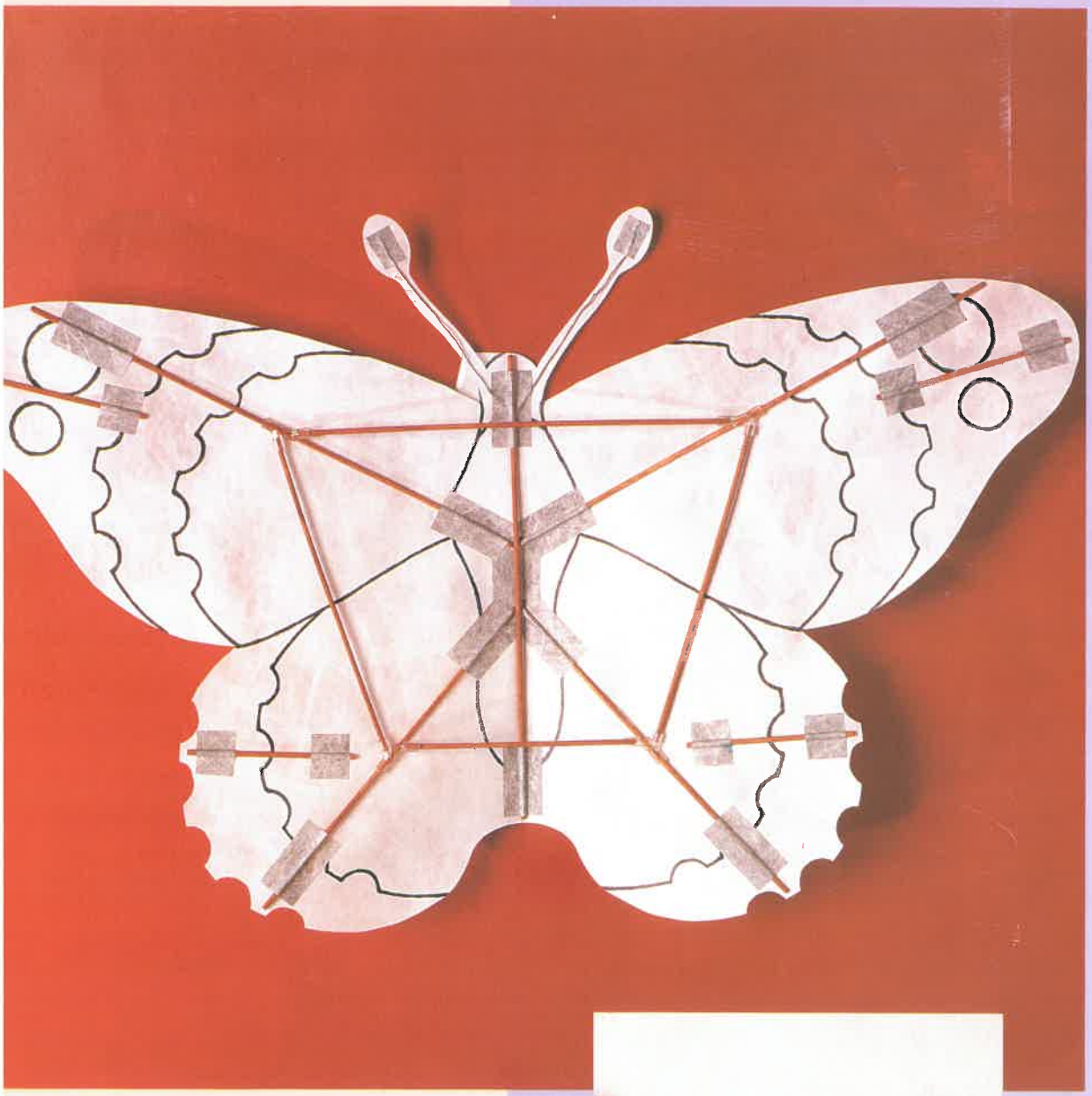
Step 20

To complete the kite, insert each end of the spreader strut or into the remaining frame joiners on the front spars (or front spars as needed).

If a tail is required, tie it to the end of the spine. Crepe paper decorating ribbon makes a good tail. A strip of Tyvek can also used. (Note: The antennae on butterflies are optional. If they included, stiffen them with wire.)

Above, a drink can pull-tab used as a towing ring and a fishing line swivel hook used to attach the flying line.

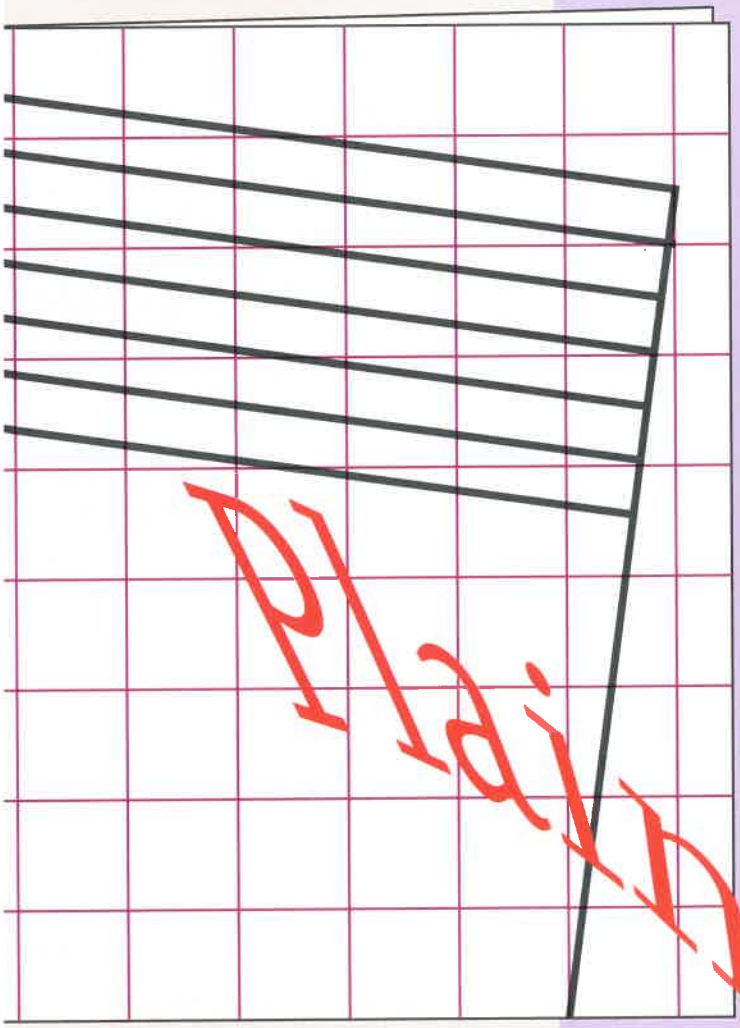
Right, the face of an unpainted kite (the Red Admiral), showing its convex shape, keel, bridle, towing ring, and flying line.



he frame of a kite (the Red Admiral),
the dowels, joiners, and tabs.

e polyethylene frame joiners in
own is the left front spar, longeron,
t connection.)

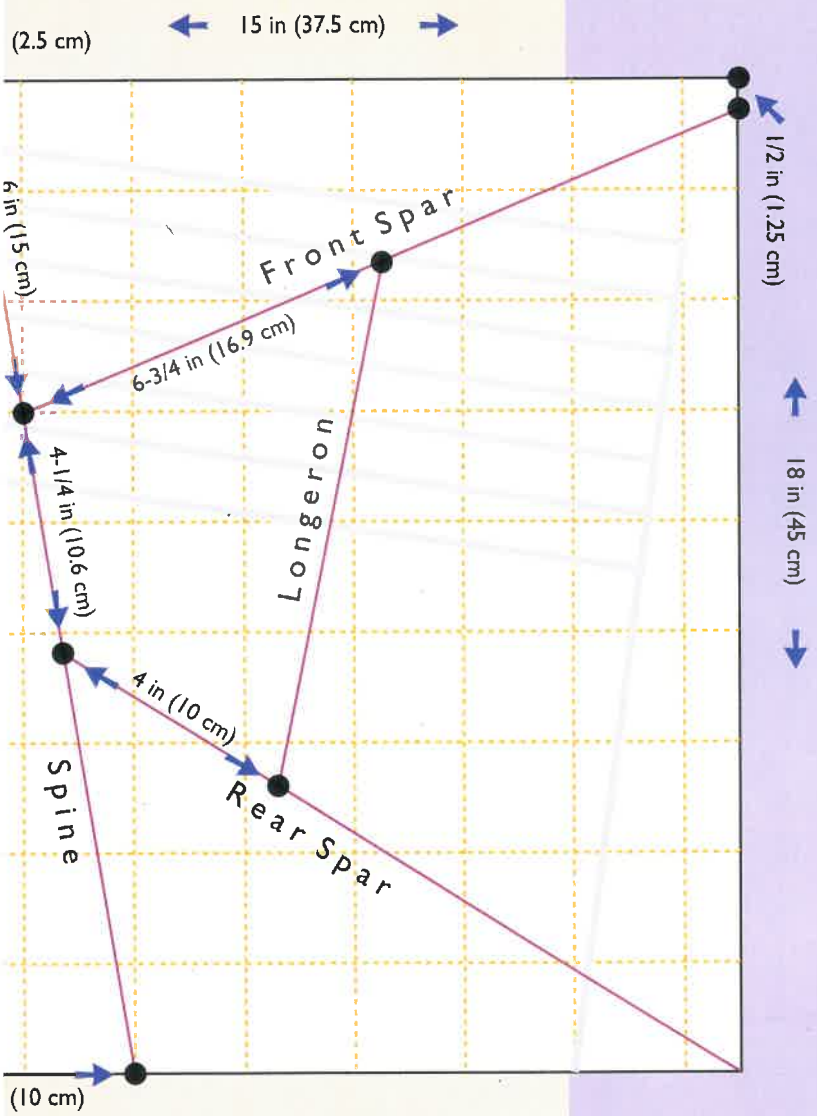
Great Kites to Build



Plain Kite

requires a Tyvek sheet size of
18 in (75 cm x 45 cm).

ıere is the sheet folded in half to
18 in (37.5 cm x 45 cm), displaying the
nd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
onto the Tyvek sheet (see p 12).



Plain Kite Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

ption of framing materials

wood dowel – 1/8 in x 18 in (.3 cm x 37.5 cm)
pport: 1 wood dowel – 1/8 in x 18 in (.3 cm x 37.5 cm)
ars: 2 wood dowels – 1/8 in x 13-1/2 in (.3 cm x 33.8 cm)
spars: none
ars: 2 wood dowels – 1/8 in x 13-1/2 in (.3 cm x 33.8 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 9 in (22.5 cm)
reader strut: 1 wood dowel – 1/8 in x 11-1/4 in (.3 cm x 28 cm)
reader strut: 1 wood dowel – 1/8 in x 5 in (.3 cm x 12.5 cm)
ylene joiners: 8 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ry supports: none
g tabs: about 13 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

From mythical origins to high technolog

Probably as early as 1000 B.C. ancient Chinese flew so bamboo and silk kites. This highly developed tool-using all the right ingredients to make kiting possible – lightv bamboo plants for frames, silkworm culture for cloth an and ingenious craftsmanship.

Kites continued to gain cultural status. Legends, both and military, contributed to the kite's imp They described how soldiers were lofted to enemy encampments and of kites mediatin spirits, believed to inhabit the sky.

By the first century A.D. the Chinese dis how to make a delicate paper from the inner the mulberry tree, the leaves of which were th diet of silkworms. This paper came to replace s primary writing material and was used for kite The first kites were probably rectangular, but lat exotic kites were made in the shapes of birds, ins animals, imaginary creatures, and even people. The of paper played a major role in popularizing the a making. An annual Chinese Kite Day was celebrate regions and a variety of local kite traditions arose.

With the coming of the industrialized age and w urbanization, the art of kiting has diminished in Chi During Mao Tse Tung's Cultural Revolution of the 19 flying was outlawed and became an underground activi since regained favor and today is considered an importa the Chinese cultural heritage.

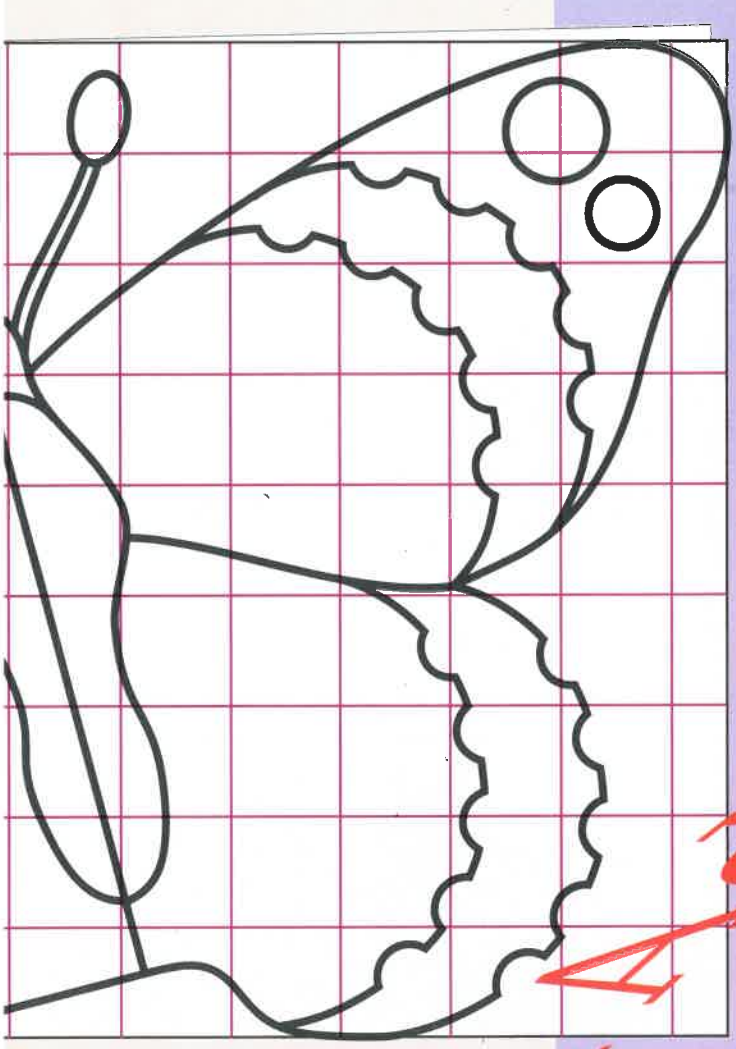
During the Tang Dynasty (618 A.D.–907 A.D.), the traditions of kiting were carried by wandering Buddhist from ancient China across Indo-China to the islands of

Of kites and chrysanthemums

The myth of Haun Ching tells how a Chinese peasant farmer visited a local fortune-teller, who predicted calamity for the man and his family on the ninth day of the ninth month. These ancient people believed that the sky was the home of spirits. He said to avert disaster, the man should take his family to the distant hills on that day. There they were to drink wine made from chrysanthemum flowers and fly kites that could reach the spirit world in the sky and carry away their misfortunes.

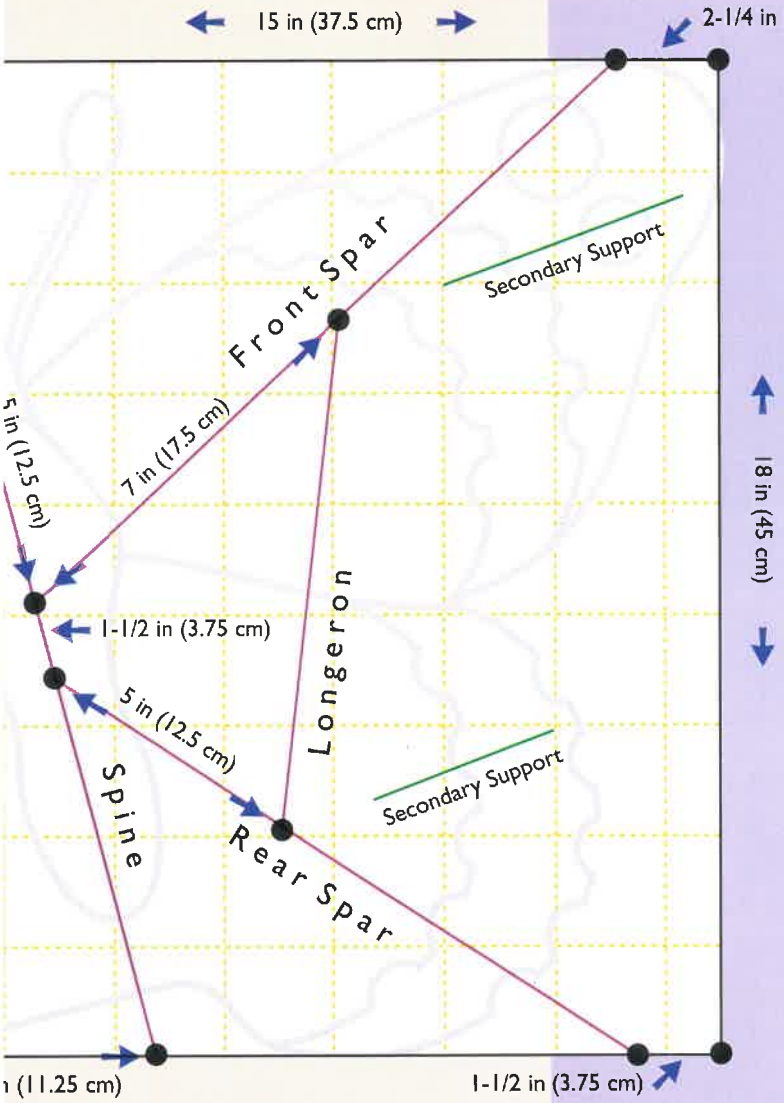
When the family returned to their village that evening, they found all the barnyard animals dead. Since then, on the anniversary of their escape from death, the family and the villagers went to the hills to fly kites. Eventually people believed that an entire year's misfortunes could be averted by flying kites on that day.

This is the origin of Chinese Kite Day, an ancient festival that has been celebrated widely across the entire country.



This kite requires a Tyvek sheet size of 30 in x 18 in (75 cm x 45 cm).

Shown here is the sheet folded in half to 15 in x 18 in (37.5 cm x 45 cm), displaying the **righthand** side of the kite's face pattern. A 2 inch (5 cm) grid is used to facilitate in transferring the pattern onto the Tyvek sheet (see p 12).



Red Admiral Frame Layout

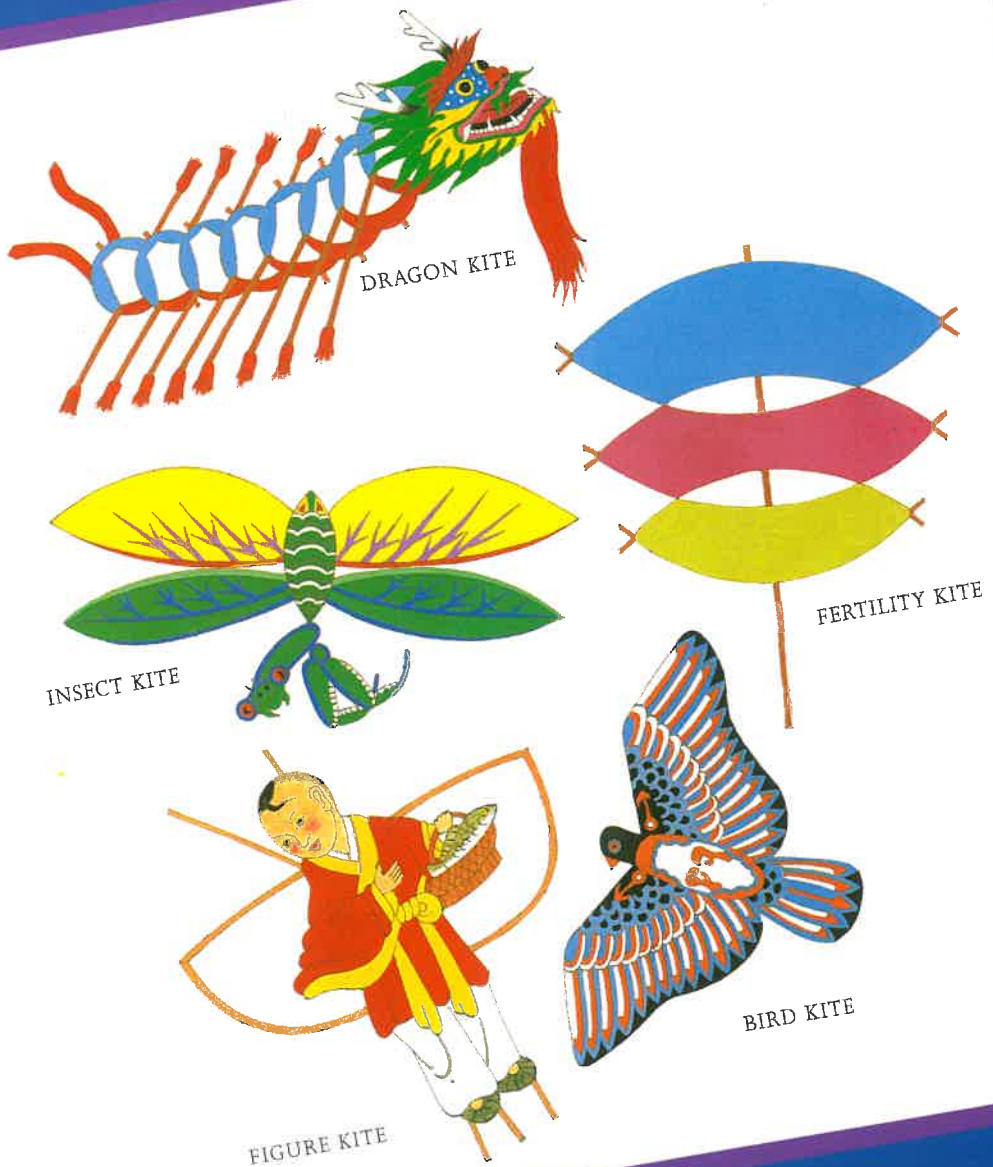
Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

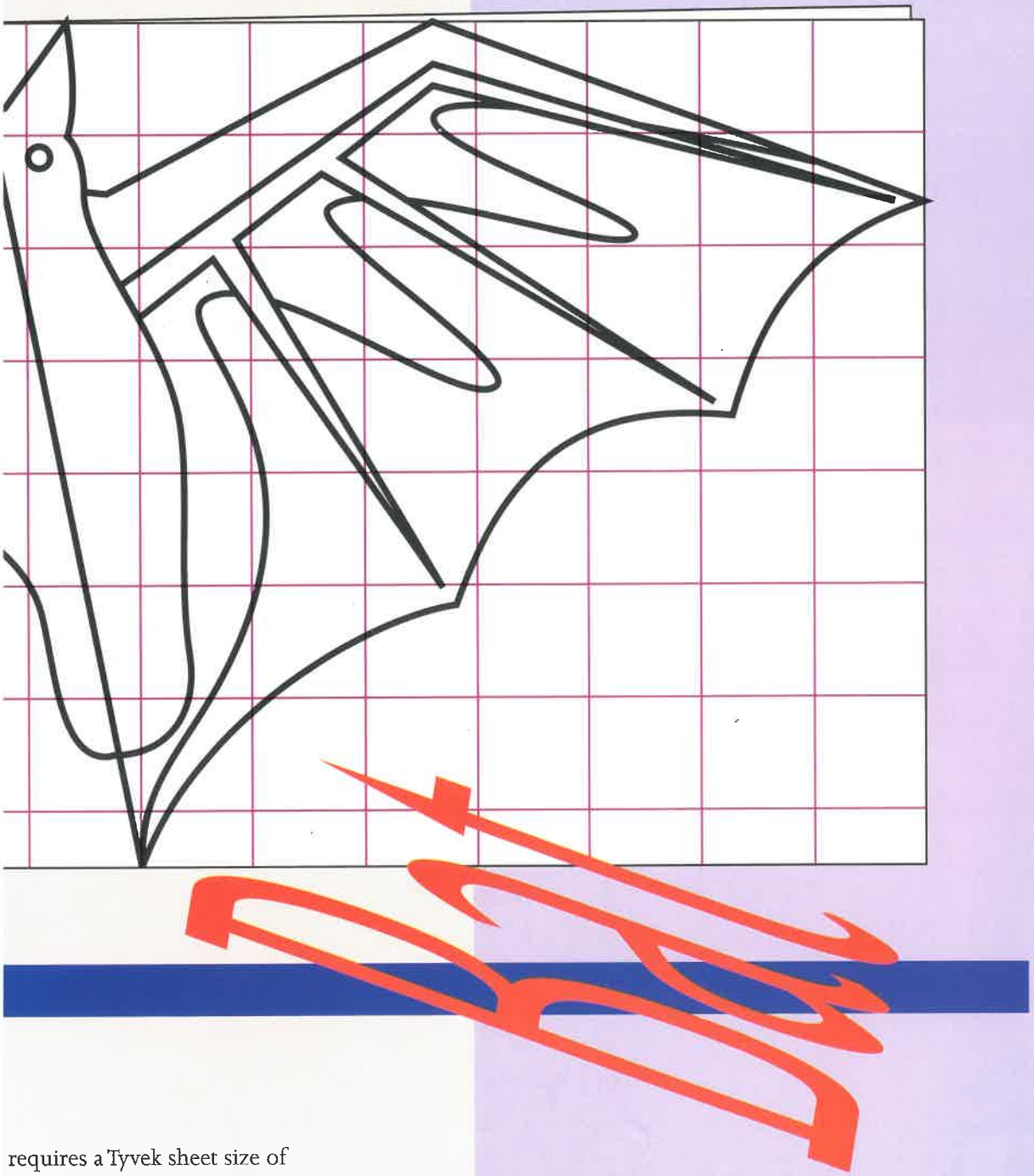
tion of framing materials

wood dowel – 1/8 in x 12-1/4 in (.3 cm x 30.6 cm)
ort: 1 wood dowel – 1/8 in x 13 in (.3 cm x 32.5 cm)
rs: 2 wood dowels – 1/8 in x 13-1/2 in (.3 cm x 33.8 cm)
spars: none
s: 2 wood dowels – 1/8 in x 10 in (.3 cm x 25 cm)
s: 2 wood dowels – measure and cut to fit, approximately 8-1/2 in (21.3 cm)
eader strut: 1 wood dowel – 1/8 in x 11 in (.3 cm x 27.5 cm)
ader strut: 1 wood dowel – 1/8 in x 6 in (.3 cm x 15 cm)
ene joiners: 8 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
y supports: 1/8 in wood dowels – 4 short pieces
tabs: about 18 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

In Japan, kites first became an important part of Bu religious ritual, and were flown only by the aristocracy. particular ceremony involved tying unthreshed rice to a flying it over growing crops, intending to invoke the god provide an abundant rice harvest.

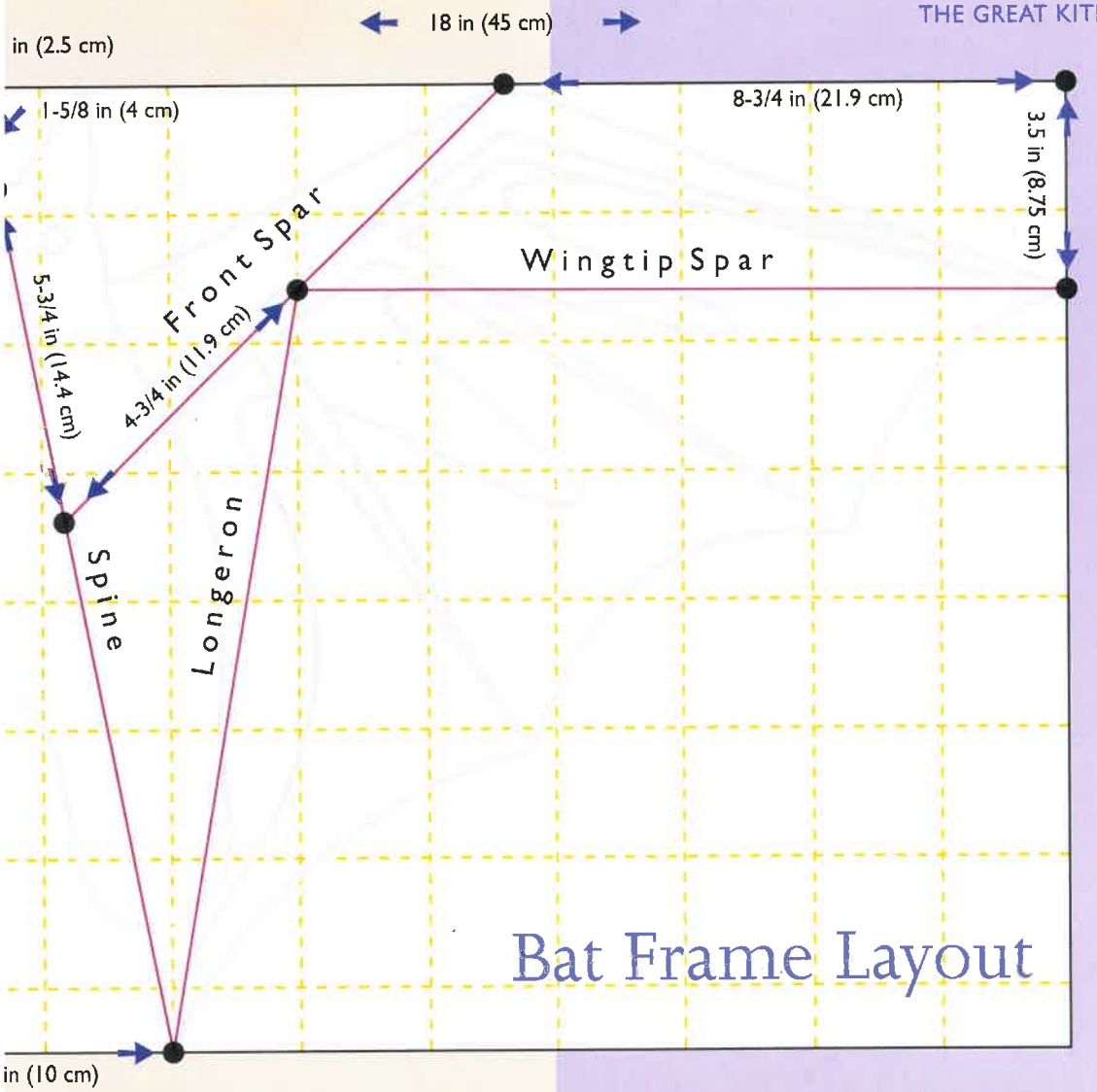
Traditional Chinese kites.





requires a Tyvek sheet size of
.5 in (90 cm x 37.5 cm).

ere is the sheet folded in half to
.5 in (45 cm x 37.5 cm), displaying the
nd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
onto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

ption of framing materials

l wood dowel – 1/8 in x 14 in (.3 cm x 35 cm)
pport: 1 wood dowel – 1/8 in x 13-1/2 in (.3 cm x 33.8 cm)
ɔars: 2 wood dowels – 1/8 in x 9-1/2 in (.3 cm x 23.8 cm)
p spars: 2 wood dowels – 1/8 in x 11 in (.3 cm x 27.5 cm)
ars: none
ɔns: 2 wood dowels – measure and cut to fit, approximately 9-1/2 in (23.8 cm)
ɔreader strut: 1 wood dowel – 1/8 in x 6-3/4 in (.3 cm x 16.9 cm)
reader strut: none
ylene joiners: 4 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ary supports: none
ng tabs: about 9 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

Victory by kite

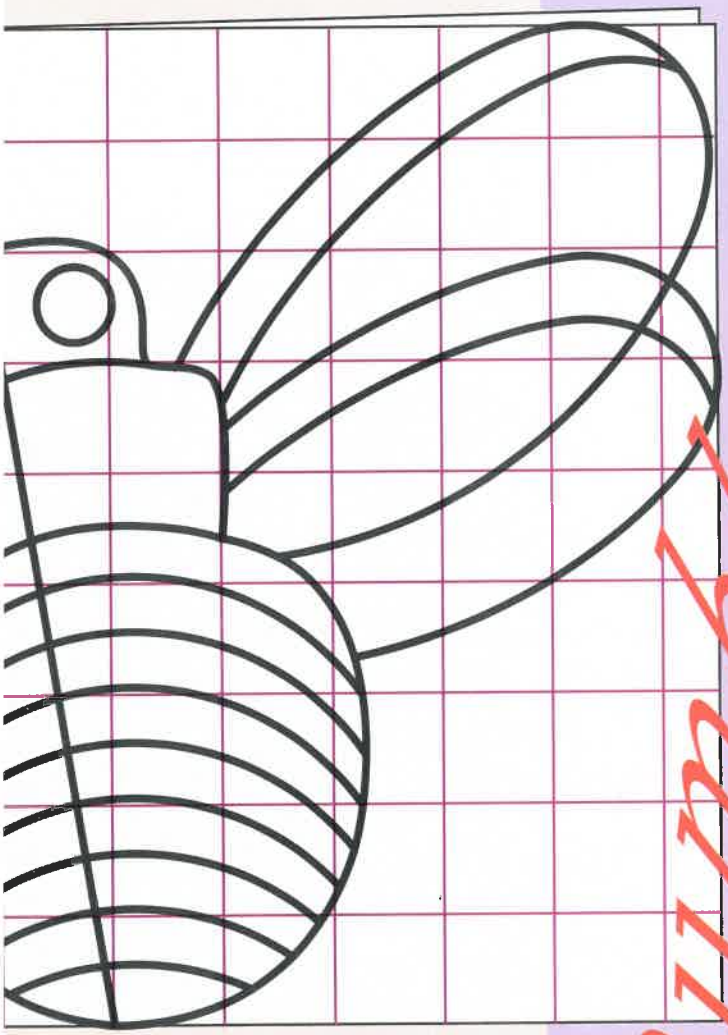
During the bloody territorial battles of ancient China, the warlord Liu Pang was attempting to overthrow the existing rule of Huan Theng who seemed certain to lose.

Legend has it that on the very day that defeat seemed imminent, a gust of wind blew Huan Theng's hat from his head, giving him an idea. He had each of his men build a kite fitted with a noise maker (probably a buzzer made by attaching bamboo strips to a taut string).

After dark the soldiers released the kites on the night wind high above the heads of Liu Pang's sleeping men. For those people the sky was the home of spirits. Being wakened out of a dead sleep by shrieking and wailing overhead, the bewildered soldiers thought they were being attacked by a horde of demons. Terrified, they fled, giving Huan Theng the victory.

By the Edo period (1603–1868) kites became un popular in Japan. They bore likenesses of famous person Japanese kabuki theater and heroes from the art of woo printing. To celebrate the reconstruction of the Renqiji T 1692, giant kites such as the oval wan-wan were flow was the largest kite ever built, about 65 feet (20 m) i and weighing about 5,500 pounds (2,500 kg). It to 200 strong men to fly it. Sometimes, if the wind di subside overnight, it remained airborne for days be was impossible to haul down.

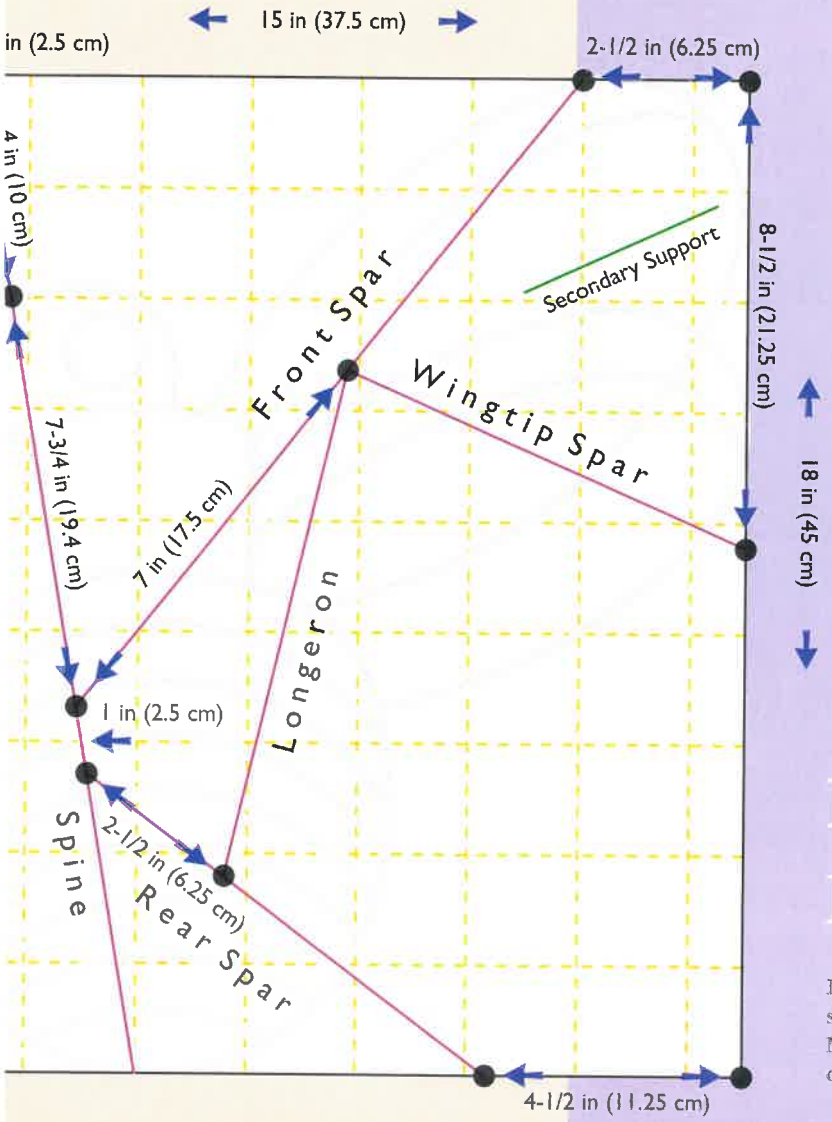
Another event involving giant kites has becor Japanese tradition. In 1737 a canal that divid Shirone district into eastern and western regi rebuilt after it had collapsed during a flood. celebration, Mizoguchi, lord of the local ca the village of East Shirone a giant kite. Unfortunately it accidentally crashed in Shirone causing widespread damage to crops. The farmers wanted to fight. I war with weapons, Mizoguchi orga kite battle. To this day, every June, teams consisting of about fifty pa each, from both East and West Shirone, h five-day mock battle with giant o-dako (rectangular) rokkaku (hexagonal) kites to celebrate the event. Many of kites are involved, the sky becoming a tangle of lines. kites themselves have been destroyed, the event ends with spectators joining the team members in a gigantic tug-o with the mass of kite lines. The side having the most lin declared the winner.



Bumble Bee

requires a Tyvek sheet size of
8 in (75 cm x 45 cm).

ere is the sheet folded in half to
8 in (37.5 cm x 45 cm), displaying the
id side of the kite's face pattern. A 2 inch
rid is used to facilitate in transferring the
nto the Tyvek sheet (see p 12).



Bumble Bee Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

ption of framing materials

wood dowel – 1/8 in x 14 in (.3 cm x 35 cm)
port: 1 wood dowel – 1/8 in x 14 in (.3 cm x 35 cm)
ars: 2 wood dowels – 1/8 in x 14 in (.3 cm x 35 cm)
spars: 2 wood dowels – 1/8 in x 7 in (.3 cm x 17.5 cm)
rs: 2 wood dowels – 1/8 in x 5 in (.3 cm x 12.5 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 7-1/2 in (18.8 cm)
reader strut: 1 wood dowel – 1/8 in x 8-1/2 in (.3 cm x 21.3 cm)
eader strut: none
lene joiners: 6 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ry supports: 1/8 in wood dowels – 2 short pieces
g tabs: about 11 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

Smaller, more maneuverable "fighting" kites were int
to Japan in the Edo period by traders from the Dutch E
through the port city of Nagasaki. They are called Nag
kites and still bear the colors of the Dutch flag.

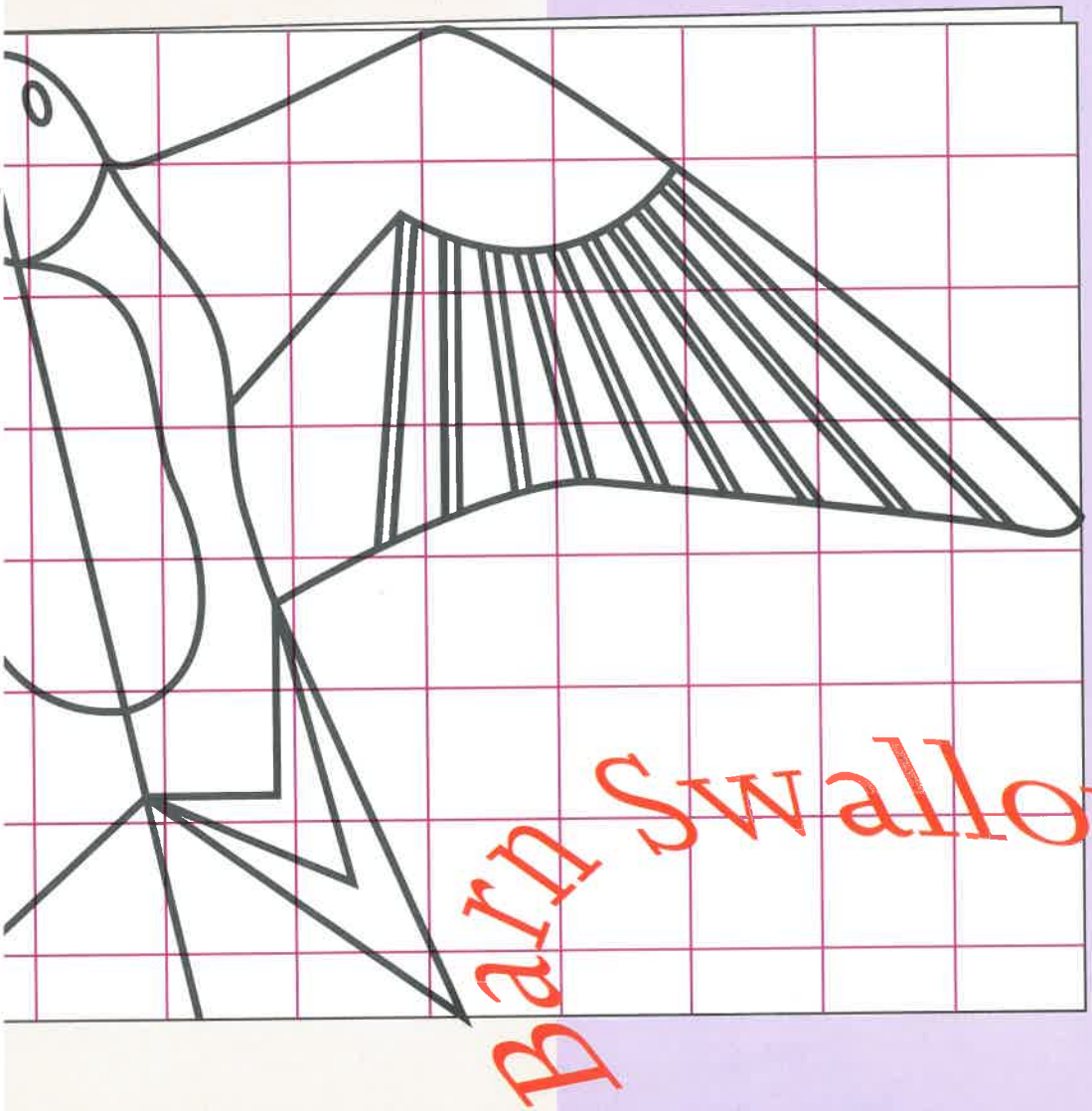
Another festival in Japan involving kites is Children'
celebrated on the fifth day of the fifth month. Many kit
flown to celebrate births in the preceding twelve months.
honor of their newborn children, families also fly highly
decorative and brightly colored windsocks in the shape o
fish prized in Japan. Carp windsocks are usually set on a
pole in the family garden, but sometimes they are attach
kite lines and flown high in the sky. As the windsocks fi
air and begin to move, they resemble carp swimming ag
strong current. This is a sign of strength and vigor, symb
the hoped-for progress in the children's lives.

Traveling samuri warriors and traders carried Edo kit
outlying regions of the country, where they became the b
the development of distinctive regional kite styles, made
master builders. Sadly, the Japanese art of kiting is in de
The aging kite makers who learned the art from their
are no longer passing it along to the next generation.

The wandering monks who brought kites to anci
Japan also brought them to other asiatic regions. Kor
became avid kite flyers and also developed kiting cus
intended to ensure good fortune for their children. I
Malaysia, the tradition of flying kites to curry fav
the spirits to provide a rich harvest was also pract
first kites of simple design were involved, but in t
more highly decorated kites were constructed to v
the bestowing of greater favors. Kites were made from ri
embellished and brightly colored glazed tissue paper with

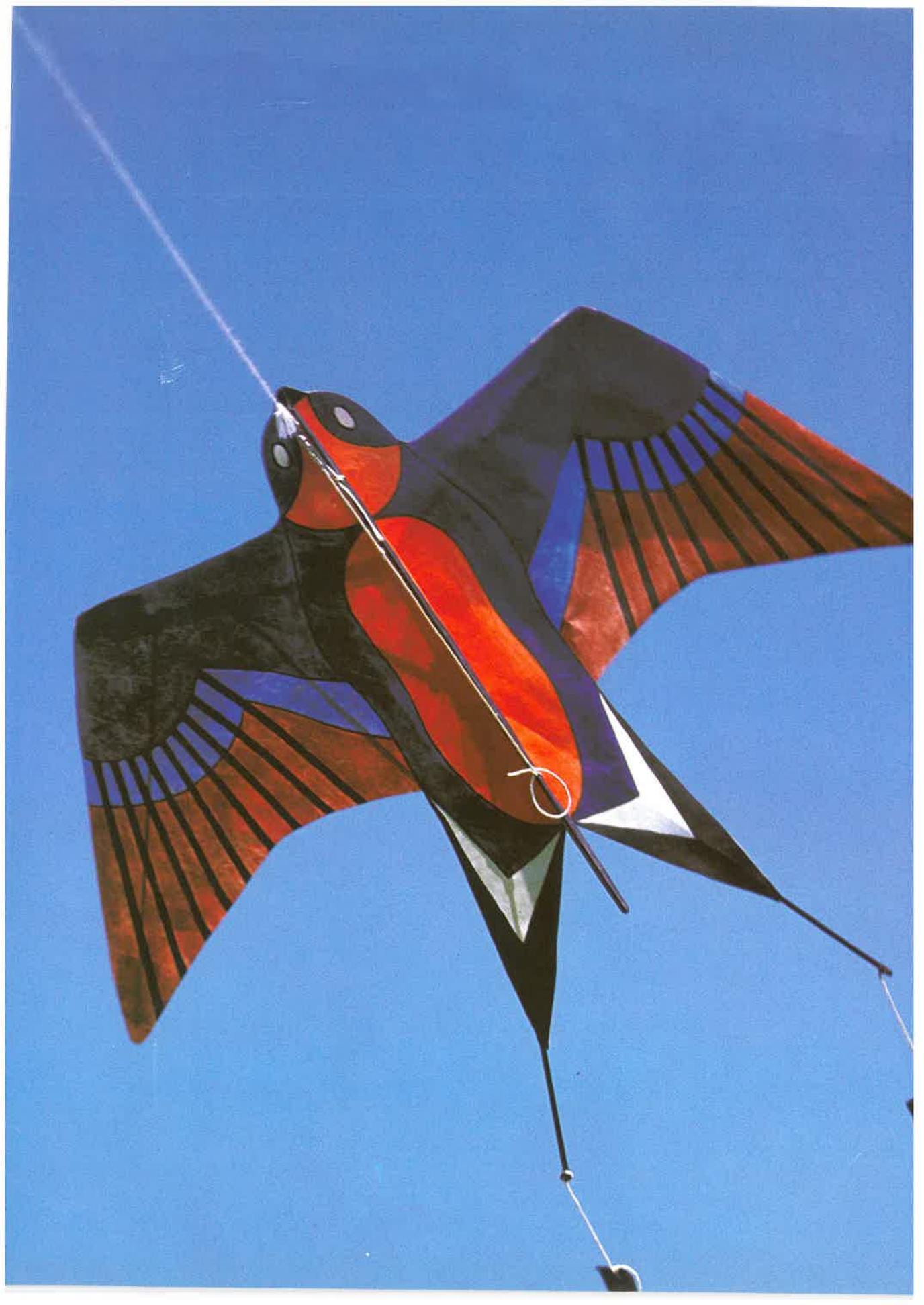
The great escape

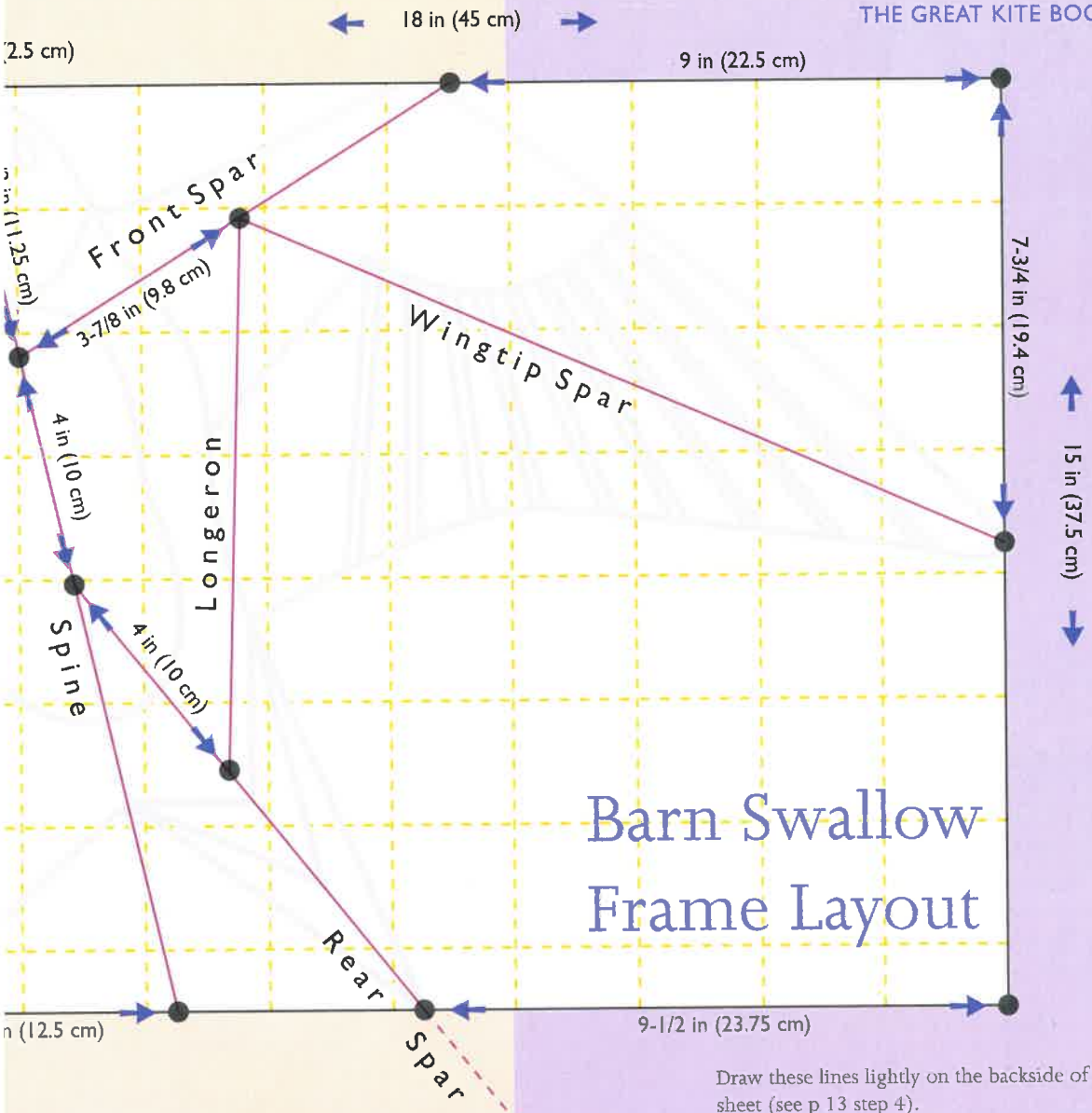
In ancient Japan the Shogun Minamoto no Tametomo of the Genji clan, and his young son, were exiled to the remote island of Hachijo by a rival clan. To escape the desolate place, the father built a large kite. When the wind was favorable, his son climbed aboard and was carried safely back to the mainland where he built a huge bonfire to signal to his father that he had arrived safely and was on his way to gather support for their clan. Since that time the traditional Hachijo kite has borne the likeness of Tametomo upon its sail.



: requires a Tyvek sheet size of
15 in (90 cm x 37.5 cm).

ıere is the sheet folded in half to
15 in (45 cm x 37.5 cm), displaying the
ınd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
ɔnto the Tyvek sheet (see p 12).





Barn Swallow Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

tion of framing materials

wood dowel – 1/8 in x 12 in (.3 cm x 30 cm)
ort: 1 wood dowel – 1/8 in x 14 in (.3 cm x 35 cm)
rs: 2 wood dowels – 1/8 in x 7-3/4 in (.3 cm x 19.4 cm)
spars: 2 wood dowels 1/8 in x 12 in (.3 cm x 30 cm)
s: 2 wood dowels – 1/8 in x 14 in (.3 cm x 35 cm)
is: 2 wood dowels – measure and cut to fit, approximately 8-1/2 in (21.3 cm)
eader strut: 1 wood dowel – 1/8 in x 6-1/4 in (.3 cm x 15.6 cm)
ader strut: none
ene joiners: 6 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
y supports: none
tabs: about 11 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

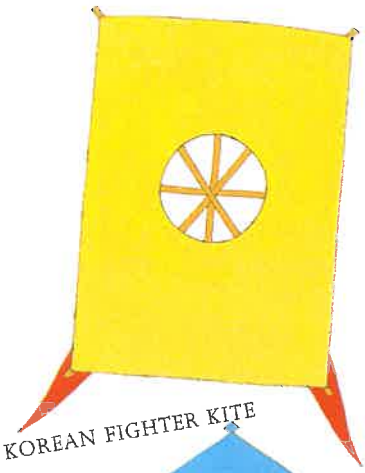
and leaf patterns. Many had buzzers attached, making th
"come alive" when airborne, thus better able to commun
spirits. To this day between April and June – the monsoo
when farmers have time to enjoy the fruits of their labo
make and fly highly decorated kites known as wau bula

Traditional Japanese and Korean kites.

CARP WINDSOCK

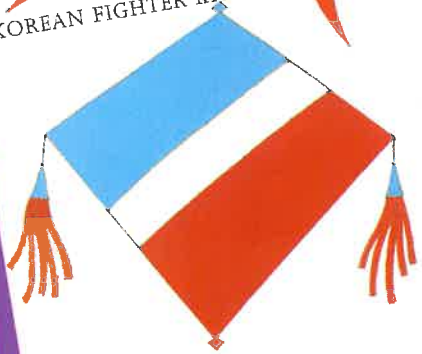
EDO KITE

O-DAKO KITE

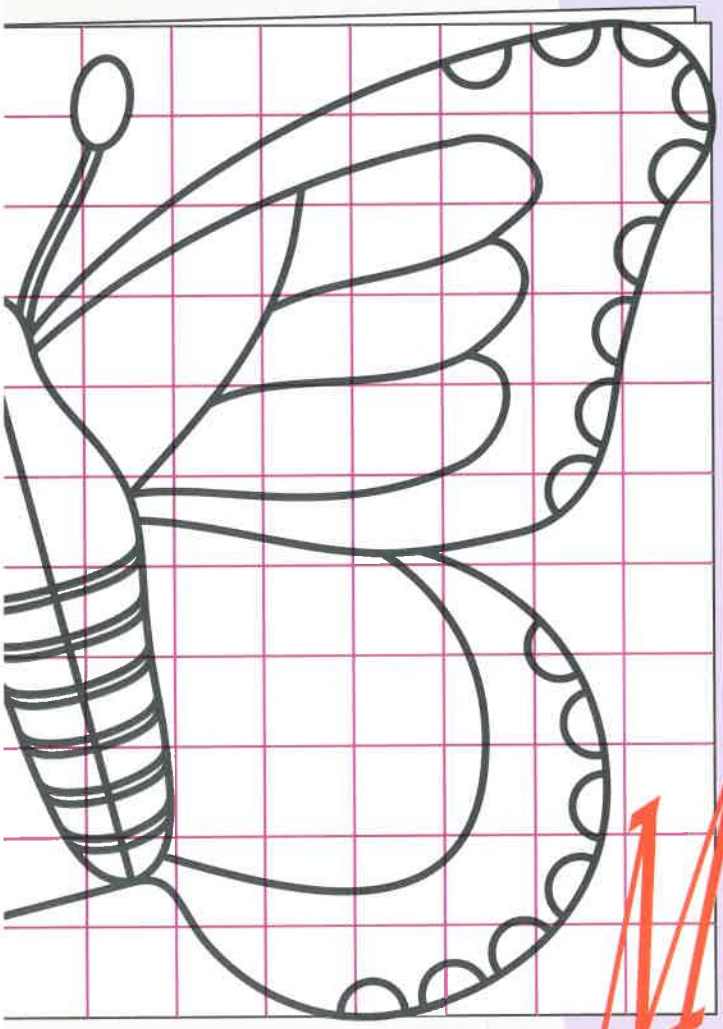


KOREAN FIGHTER KITE

ROKKAKU KITE



NAGASAKI HATA KITE



Monarch

e requires a Tyvek sheet size of
22 in (90 cm x 55 cm).

here is the sheet folded in half to
22 in (45 cm x 55 cm), displaying the
ind side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
onto the Tyvek sheet (see p 12).

fertility ritual, not unlike the one practiced in Japan. The even bear similar features. It is entirely possible that they common origin, now lost in antiquity.

In ancient Polynesia kites were considered a gift from gods and used to help catch fish. A length of line, tipped bone fishing hook, was suspended from the tail of a leaf supported by a light frame of twigs. Letting this kite fly water gave the fishermen on the banks a greater fishing ra Besides this practical use, kites were also used for sport in competitive community games.

In ancient New Zealand, Maori had manu (bird) kite were half human, half bird, in shape. Birds in their cultu messengers of the gods, and such kites were used in divina ceremonies and also flown as an act of good will.

Indonesian Hindus on the island of Bali flew honor of the gods Vishnu and Siva. According to l these gods helped rid the land of an evil king.

In Thailand the month of March is the time fo annual kite tournament. Kite "fighting" dates back time of King Rammi II (1809–1892). He would large human-shaped kite, known as a chula (male), palace grounds. For sport, he allowed his courtiers to f smaller diamond-shaped kites, called pakpao (female), he then attempted to snag with his larger kite. The gam declared a national sport in 1921, allowing both royalt commoners to enter teams.

In today's version the large chula is equipped with thre of large barbs and the small pakpao with a large loop of st dangling beneath it. To play the game, a line is drawn on t ground, to divide the field into two sections. The chula is launched across this divide to where a large number of pak

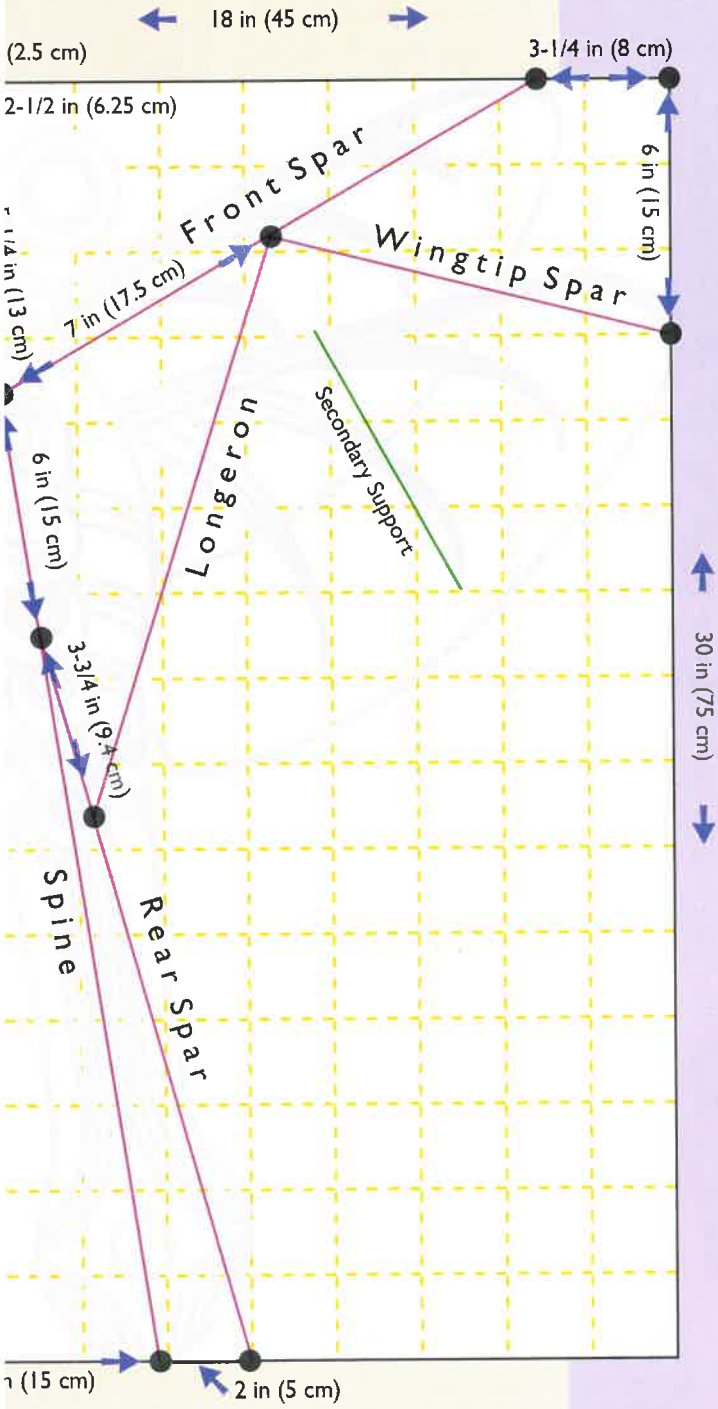
Shooting stars

General Gim Yu-Sin, was sent by Queen Zindong of Korea to subdue an uprising led by two rebels, Bi-Dam and Yom-Zong. On the night before battle a large shooting star streaked across the sky over the heads of Gim Yu-Sin's encamped soldiers. Believing this bad omen meant that the heavenly spirits were displeased, the soldiers refused to fight the rebels. Legend holds that to appease the men the general built a large kite, attached a giant fireworks fireball to it, and sent it aloft on the night breeze, thus symbolically returning the bad omen to the heavens. The next day the battle was fought and won.

This kite requires a Tyvek sheet size of 36 in x 30 in (90 cm x 75 cm).

Shown here is the sheet folded in half to 18 in x 30 in (45 cm x 75 cm), displaying the **righthand** side of the kite's face pattern. A 2 inch (5 cm) grid is used to facilitate in transferring the pattern onto the Tyvek sheet (see p 12).

Dragonfly Frame Layout



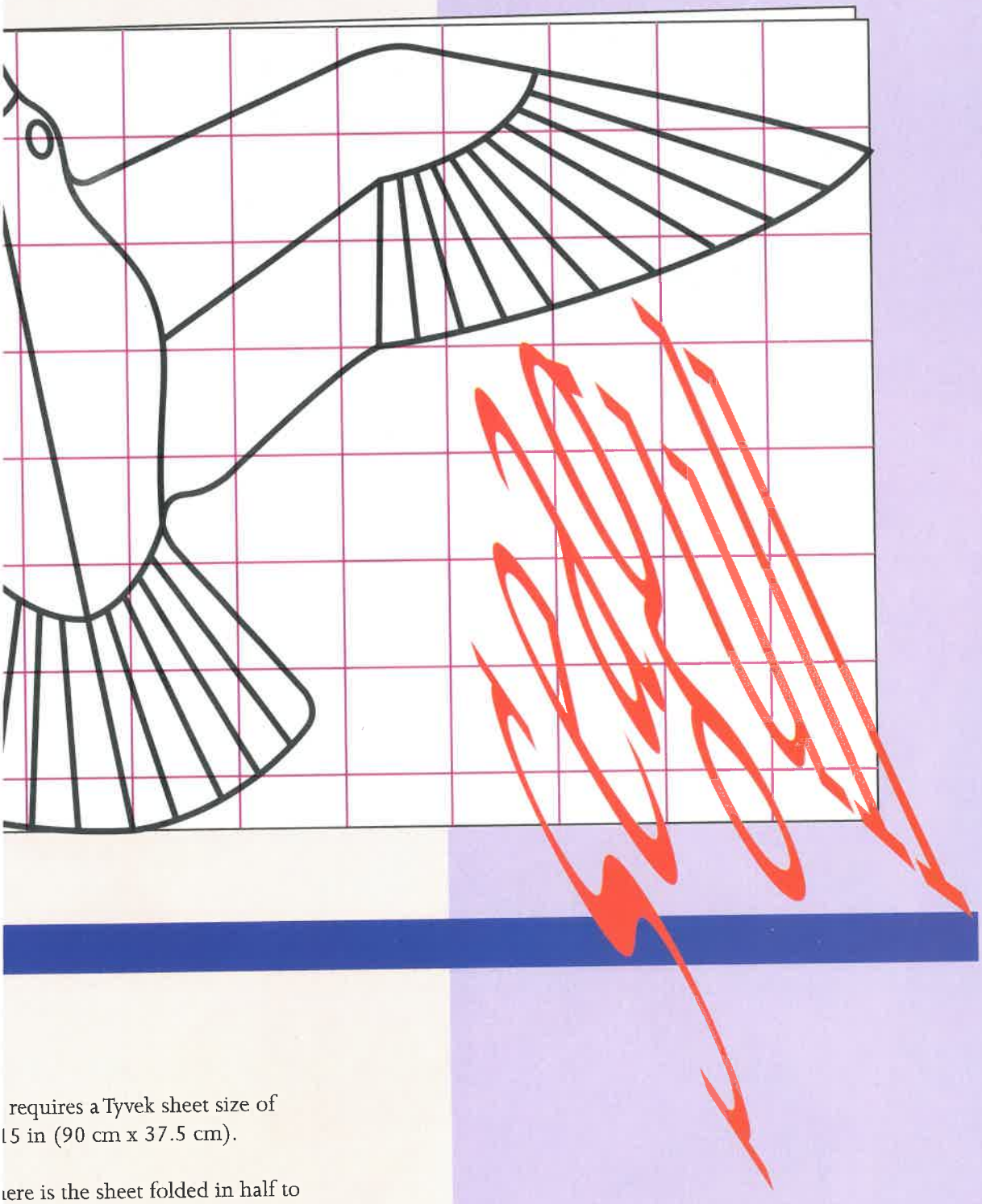
Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

Description of framing materials

Spine: 1 wood dowel –
1/8 in x 28 in (.3 cm x 70 cm)
Keel support: 1 wood dowel –
1/8 in x 28 in (.3 cm x 70 cm)
Front spars: 2 wood dowels –
1/8 in x 14 in (.3 cm x 35 cm)
Wingtip spars: 2 wood dowels –
1/8 in x 9 in (.3 cm x 22.5 cm)
Rear spars: 2 wood dowels –
1/8 in x 14 in (.3 cm x 35 cm)
Longerons: 2 wood dowels –
measure and cut to fit,
approximately 14 in (35 cm)
Front spreader strut: 1 wood dowel –
1/8 in x 11-3/4 in (.3 cm x 29 cm)
Rear spreader strut: none
Polyethylene joiners: 8 pieces –
1/8 in (.3 cm) ID, x 3/4 in (2 cm),
notched in the middle
Secondary supports:
1/8 in wood dowels – 2 short pieces
Fastening tabs:
about 20 pieces cut from scrap Tyvek,
approximately 1-1/4 x 2 in (3 cm x 5 cm)

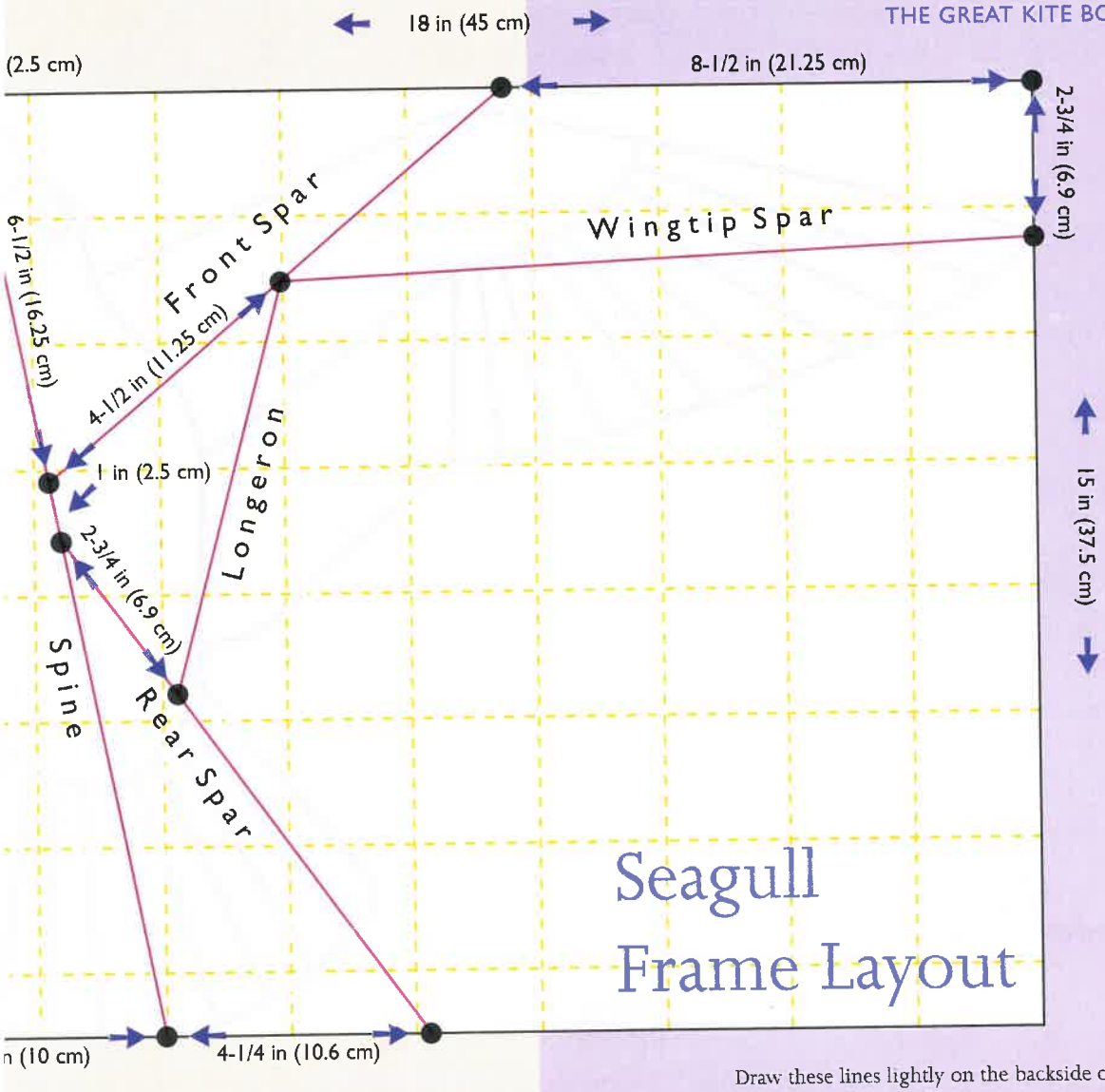
are already airborne. There are five pakpaos to each chu
object of the game is to abduct a pakpao and drag her b
across the line. The agile pakpaos, on the other hand, att
ensnare the cumbersome chula in their loops. It is an ex
action game, drawing large crowds of spectators.

Traditional Malay, Thai, Indian, and South Sea Island kites.



requires a Tyvek sheet size of
15 in (90 cm x 37.5 cm).

ıere is the sheet folded in half to
15 in (45 cm x 37.5 cm), displaying the
ınd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
ɔnto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

ption of framing materials

wood dowel – 1/8 in x 15-1/2 in (.3 cm x 38.8 cm)
)port: 1 wood dowel – 1/8 in x 15 in (.3 cm x 37.5 cm)
)ars: 2 wood dowels – 1/8 in x 9 in (.3 cm x 22.5 cm)
) spars: 2 wood dowels – 1/8 in x 11 in (.3 cm x 27.5 cm)
ırs: 2 wood dowels – 1/8 in x 7 in (.3 cm x 17.5 cm)
)ns: 2 wood dowels – measure and cut to fit, approximately 6 in (15 cm)
)reader strut: 1 wood dowel – 1/8 in x 6-1/2 in (.3 cm x 16.3 cm)
reader strut: none
ylene joiners: 6 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ary supports: none
ıg tabs: about 10 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

In India, the winter solstice, known as Ultran is cele
with kite "fighting." Across India the skies are awash w
as thousands of people fly kites to celebrate the end of w
Opponents try to outmaneuver each other until one of t
a position to cut the line of the other. During the festiva
than a million kites are purchased from local kite vendo
purpose. Indian fighting kites are small, lightweight, and
diamond-shaped, made of split bamboo and colored tiss
They have a small fish-tail or tassel at the tail end. M
intricately decorated with abstract, bird, or animal p
To make a kite more of a threat to opponents, the u
section of the line is coated with an abrasive, cons
a mixture of glue and ground glass.

It takes great skill to fly the skittish fighting kites and maneuver them accurately into striking position.

A farmer's misdeeds

An ancient Malaysian myth explains how a farmer and his wife found an abandoned baby girl in a field. Being childless, they took the baby home and raised her as their own. As the girl grew older she became very beautiful. The farmer was infatuated with his adopted daughter, paying her every possible attention. In her jealousy, the wife became furious and beat the girl, driving her from the farm. The young beauty was never seen again.

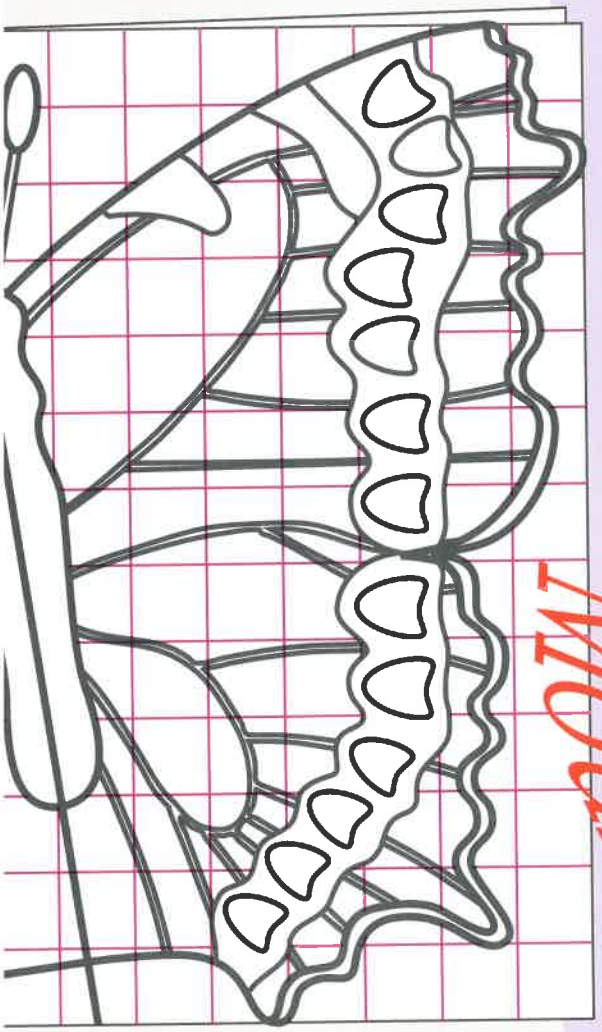
The farmer became despondent and his fields refused to yield crops. The couple traveled to consult a fortune-teller, to explain their misfortune. He said that because the young girl had come from the field, she had now become a sky spirit of the rice fields, and was preventing a harvest because of the farmer's misdeeds. By constructing a moon kite and flying it over the fields, the couple appeased the spirit and had an abundant harvest.

This is the basis of the annual Malaysian fertility ritual involving kites to invoke a bountiful harvest.

Hidden stri

According to legend, Ta
Polynesian god, became
older brother Rango's (g
and peace) growing presti
challenged him to a duel w
Whoever could fly their kit
highest would be the winner
thus gain more power. Unkno
his brother, Rango had discove
large quantity of string and this
string allowed his kite to outfly T
The two brothers remained friend
and passed on the secret of makin
kites and competition to humans.
And since ancient times kiting game
have been popular in the Polynesian
islands.

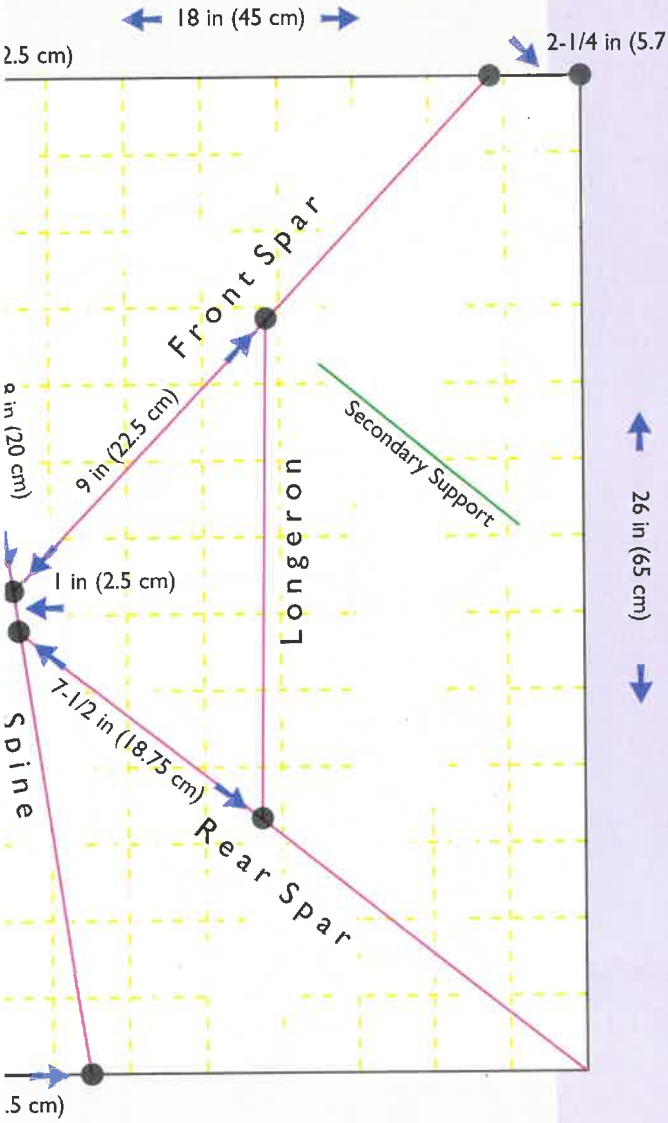
A kite bearing Rango's name is flown at the start of every game. The person whose kite achieves the greatest height is honored by having his kite designated as the god Rango. Rango has become the patron of kiting.



Morning Cloak

e requires a Tyvek sheet size of
26 in (90 cm x 65 cm).

here is the sheet folded in half to
26 in (45 cm x 65 cm), displaying the
and side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
onto the Tyvek sheet (see p 12).



Mourning Cloak Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

tion of framing materials

wood dowel – 1/8 in x 18-3/4 in (.3 cm x 46.9 cm)
port: 1 wood dowel – 1/8 in x 18-3/4 in (.3 cm x 46.9 cm)
rs: 2 wood dowels – 3/16 in x 18 in (.45 cm x 45 cm)
spars: none
s: 2 wood dowels – 3/16 in x 15 in (.45 cm x 37.5 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 11-3/4 in (29.4 cm)
eader strut: 1 wood dowel – 3/16 in x 12-3/4 in (.45 cm x 31.9 cm)
ader strut: 1 wood dowel – 3/16 in x 8-1/2 in (.45 cm x 21.3 cm)
lene joiners: 8 pieces – 3/16 in (.45 cm) ID, x 1 in (2.5 cm), notched in the middle
y supports: 1/8 in wood dowels – 2 short pieces
g tabs: about 10 pieces cut from scrap Tyvek, approximately 1-1/2 x 3 in (3.8 cm x 7.5 cm)

The shepherd and the goose feather

In Bali, the myth of the shepherd and the goose feather explains how kites came into being. A ruthless king kept everyone in poverty. One poor shepherd daydreamed of better times — of meeting and marrying a beautiful young woman and living with her in a splendid house. He even drew her imagined likeness on every occasion.

The king saw the shepherd's drawings, thought it was a real woman, and became jealous and wanted her for himself. He demanded the shepherd bring her to him, on pain of death. In fright the shepherd fled into the forest where a large and fierce monster lived. The monster wished to help the shepherd. Plucking a feather from the neck of a pure white goose, he gave it a puff of his breath and it was caught up on the wind. The monster commanded the shepherd to follow the feather wherever it led.

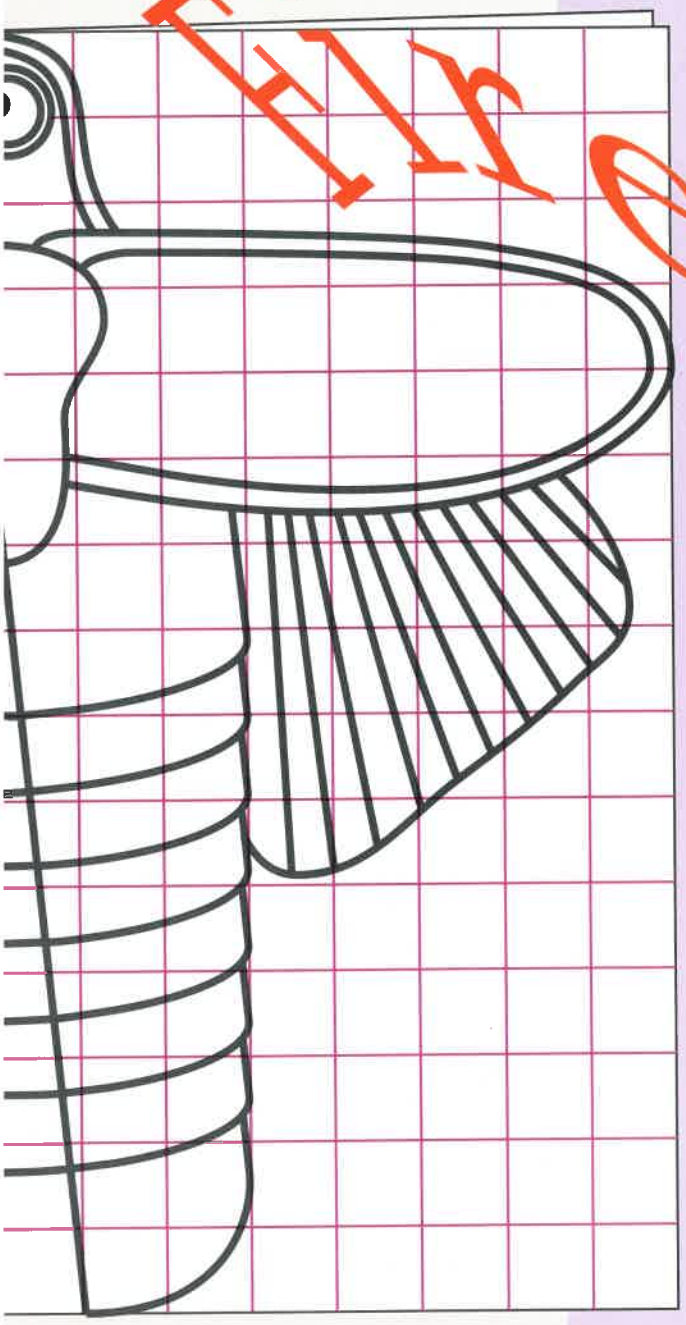
When the feather finally stopped the shepherd heard singing, then he saw a swirl of divas (spirits) led by the god Siva (destroyer). He was awestruck. The god told him that he had met every requirement of a great test of trust, and as a reward gave him not only the most beautiful diva to be his bride, but also crowned him king of the land. Siva also explained the shepherd's daydreams to him — he was no ordinary shepherd, but was a descendent of the god Vishnu (renewer). The monster, who was an agent of the gods, killed the evil king. In honor of their new king and queen, the people flew kites shaped like a goose feather.

Kite battles are undertaken in good humor. Lost kites are sacrifices to Surya the sun god. At night small paper lan lofted into the sky by tukkal kites in the god's honor.

Traders plying the world's oceans during the seventeenth nineteenth centuries probably brought kites to the Ca Islands and the Americas. Central American natives f hexagonal and octagonal kites, sun kites, at festivals of the sun, an important focus in their ancient cultu Kites in the shape of birds and other creatures were made. Traditionally, they often sported decorative b and noise makers.

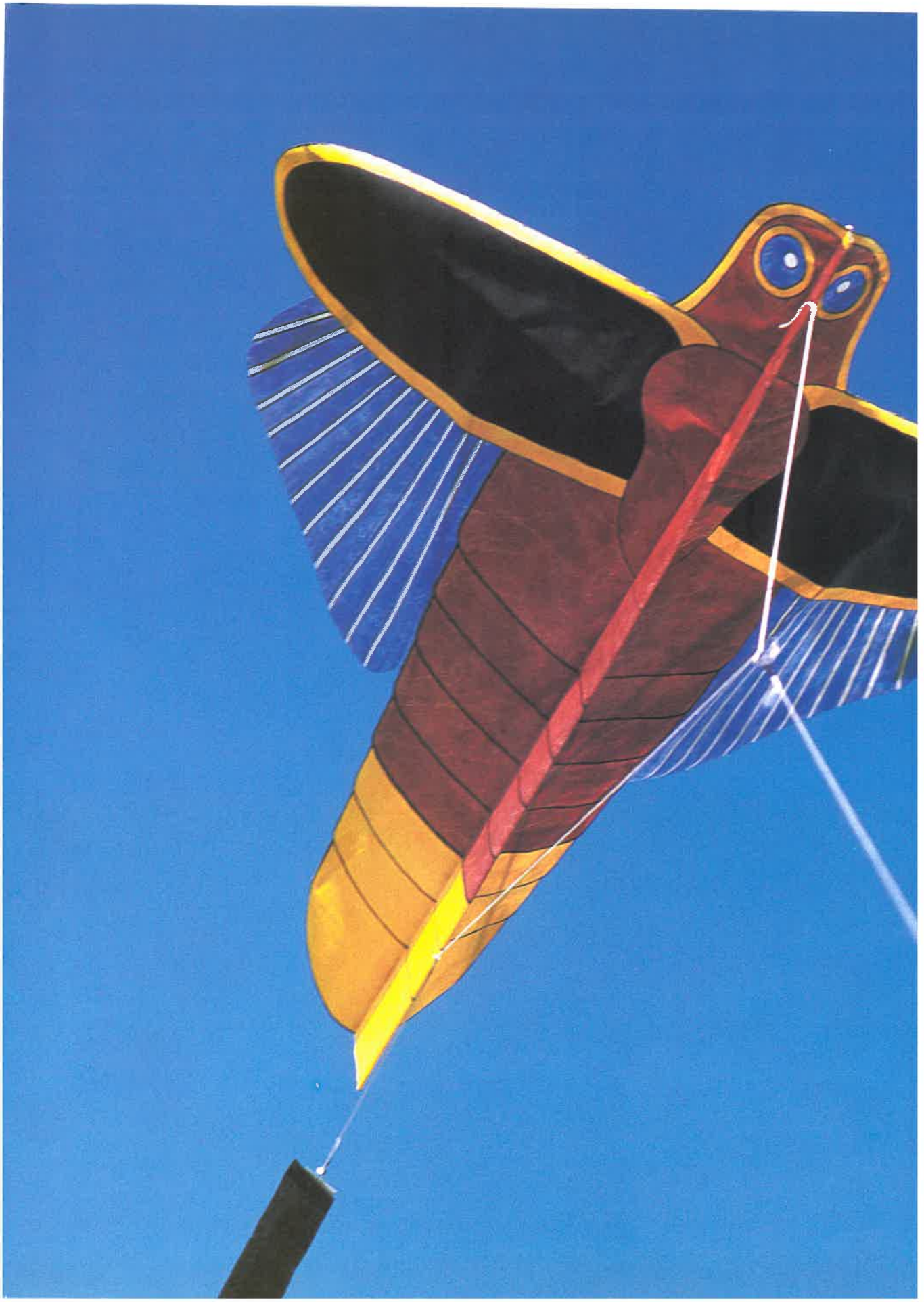
While the global traders also brought kites to kites appear to have been invented independently western world. In ancient times, the Greek philo and mathematician Archylas of Tarentum, cond aerial experiments with lightweight wood bird although it is not known if this was a kite. R legions flew dragon-shaped cloth windsocks o long poles. These airborne shapes connected w and spirits and became powerful symbols of strength, evil, and destruction. Besides havi practical use of indicating to the bowmen direction and strength of the wind, they s to writhe in the wind and served to inspi and terror in the enemy. A battlefield see alive with billowing and writhing drag a remarkable effect on enemy morale. evidence of aeronautical invention occ only after the Roman period.

Firefly



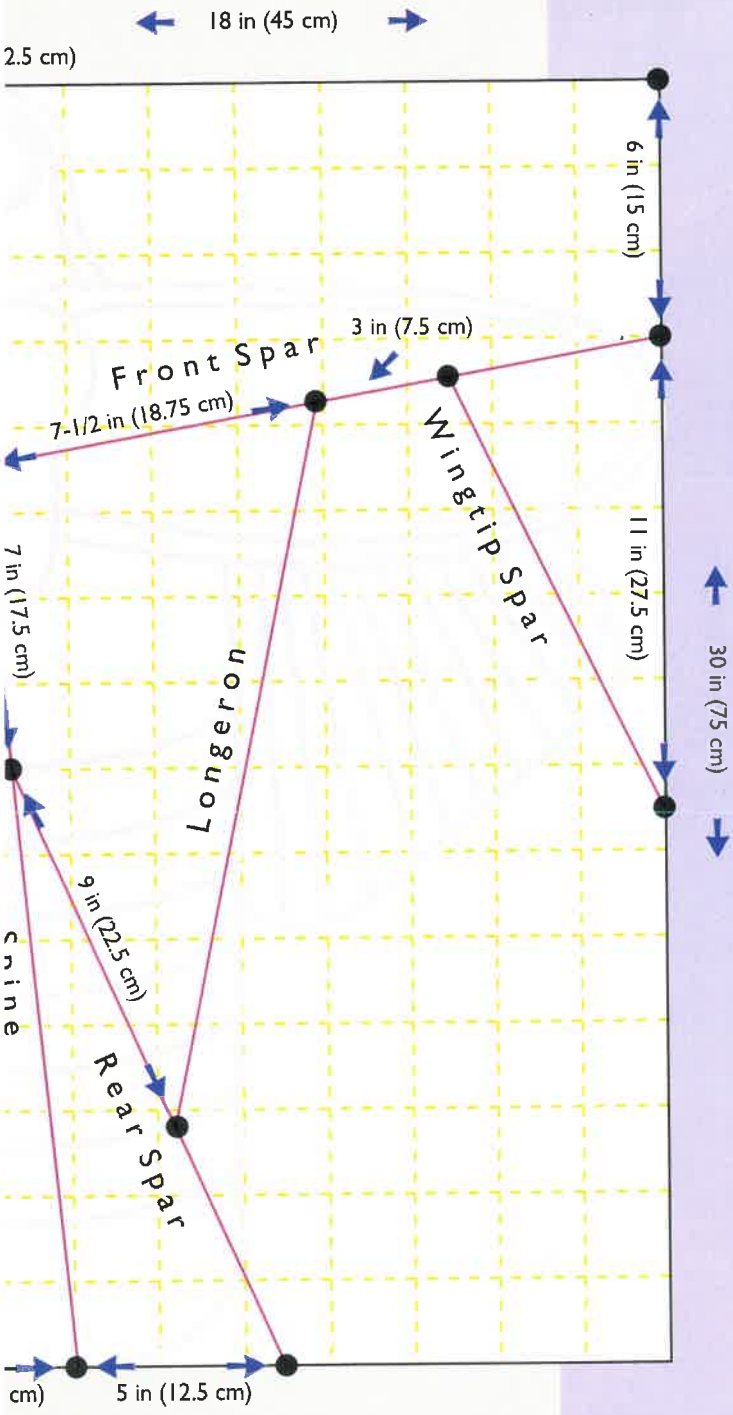
This kite requires a Tyvek sheet size of 36 in x 30 in (90 cm x 75 cm).

Shown here is the sheet folded in half to 18 in x 30 in (45 cm x 75 cm), displaying the **righthand** side of the kite's face pattern. A 2 inch (5 cm) grid is used to facilitate in transferring the pattern onto the Tyvek sheet (see p 12).



Firefly Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

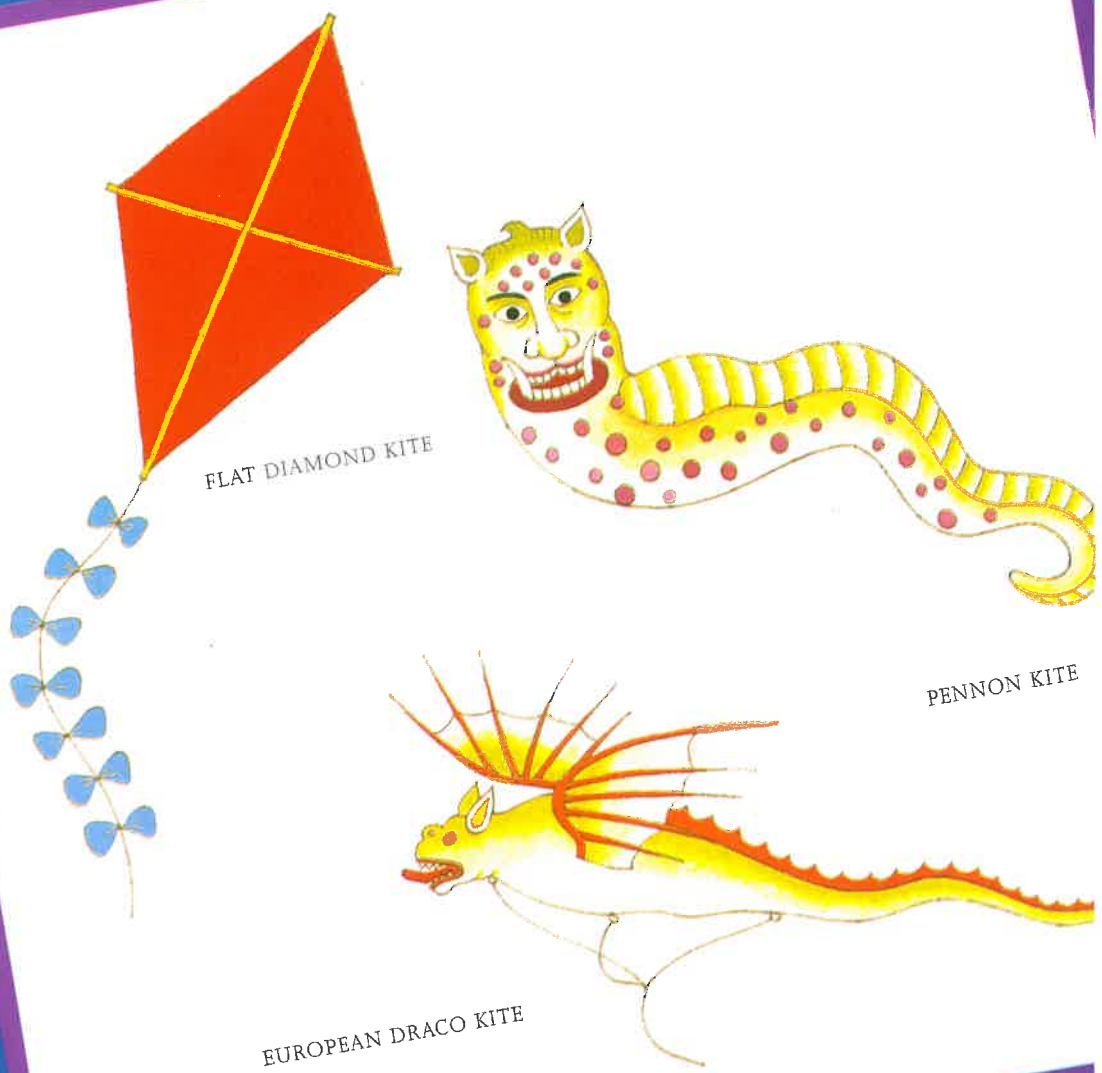


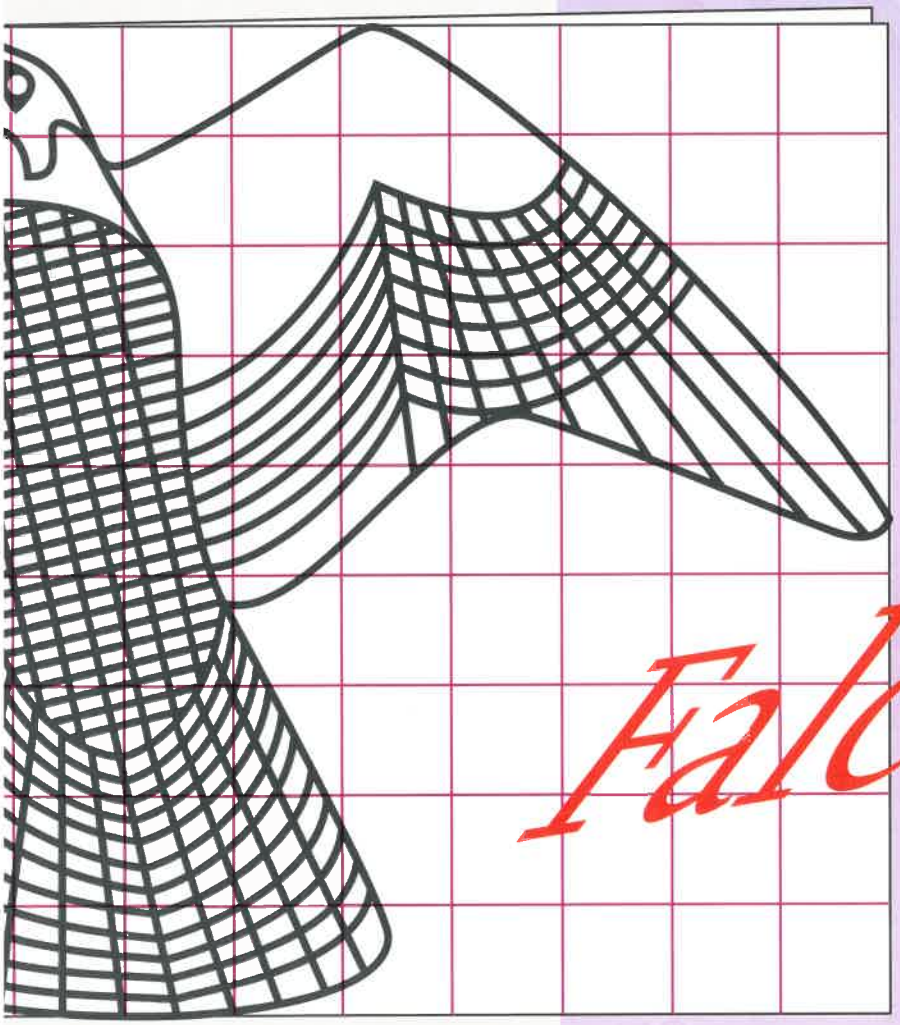
Description of framing materials

Spine: 1 wood dowel –
3/16 in x 30 in (.45 cm x 75 cm)
Keel support: 1 wood dowel –
1/8 in x 30 in (.3 cm x 75 cm)
Front spars: 2 wood dowels –
3/16 in x 15 in (.45 cm x 37.5 cm)
Wingtip spars: 2 wood dowels –
3/16 in x 8 in (.45 cm x 20 cm)
Rear spars: 2 wood dowels –
3/16 in x 12 in (.45 cm x 30 cm)
Longerons: 2 wood dowels –
measure and cut to fit,
approximately 16-1/2 in (41.3 cm)
Front spreader strut: 1 wood dowel –
3/16 in x 12-1/2 in (.45 cm x 31.3 cm)
Rear spreader strut: none
Polyethylene joiners: 8 pieces –
3/16 in (.45 cm) ID, x 1 in (2.5 cm),
notched in the middle
Secondary supports: none
Fastening tabs:
about 11 pieces cut from scrap Tyvek,
approximately 1-1/2 x 3 in
(3.8 cm x 7.5 cm)

Dragon windsocks were first flown freely on lines, kno draco kites. Then, to improve their performance, they wer out and made serpentine-like with a broad sail – pennon their symbolic strength became real. By 1326 a pennon been used by soldiers to bomb a fortress from the air.

Early European kites.

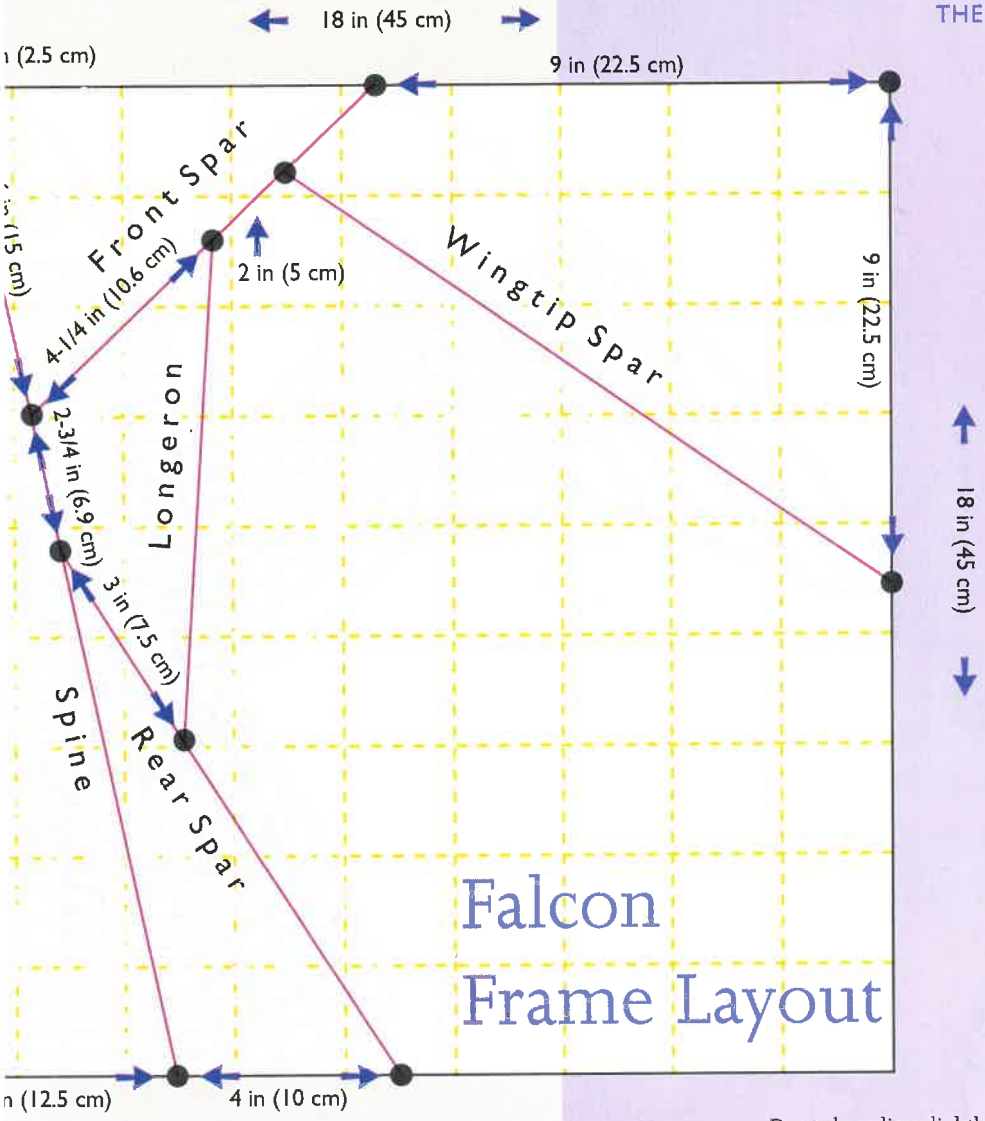




Falcon

requires a Tyvek sheet size of
18 in (90 cm x 45 cm).

ıere is the sheet folded in half to
18 in (45 cm x 45 cm), displaying the
.nd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
ɔnto the Tyvek sheet (see p 12).



Falcon Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

otion of framing materials

wood dowel – 1/8 in x 18-1/2 in (.3 cm x 46.3 cm)
port: 1 wood dowel – 1/8 in x 18 in (.3 cm x 45 cm)
ars: 2 wood dowels – 1/8 in x 8-1/2 in (.3 cm x 21.3 cm)
spars: 2 wood dowels – 1/8 in x 13 in (.3 cm x 32.5 cm)
rs: 2 wood dowels – 1/8 in x 10 in (.3 cm x 25 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 8 in (20 cm)
reader strut: 1 wood dowel – 1/8 in x 6-1/4 in (.3 cm x 15.6 cm)
eader strut: 1 wood dowel – none
lene joiners: 6 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ry supports: none
g tabs: about 11 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

In Europe kites were made of heavy cloth and wood construction and not especially airworthy. Paper had yet made there and bamboo was unknown. Kites did not fin widespread use until the advantages of lightweight const introduced from the Orient, were understood.

Kites and inventors

Two versions of kites, both flexible and light – the archt "fighters" and the Malay diamond – were the first orien introduced into Europe by Marco Polo towards the end thirteenth century. Children were attracted but kites had no cultural meaning and littl value for westerners. Builders had no unders kite aerodynamics and little interest in study therefore these styles soon lost much of their and airworthiness. The flat diamond with a lo bows seen in old picture books – not a very go became the "standard kite" in Europe and Amer

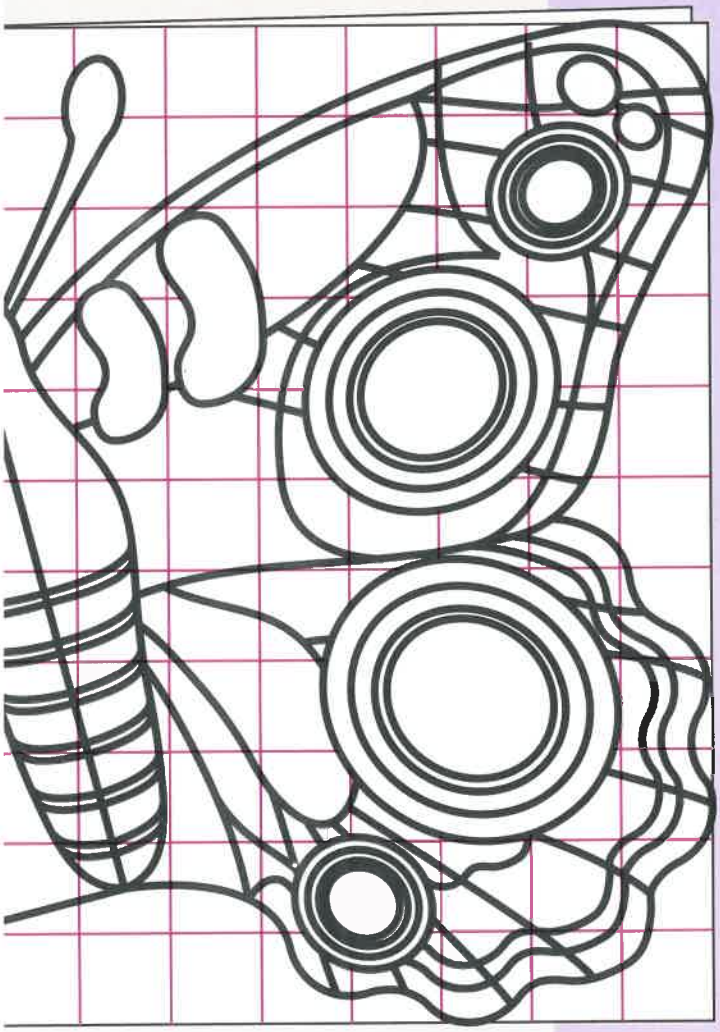
Kites assumed real practical value in 1749 w Alexander Wilson used them to determine the di of air temperature at various altitudes. He was th fly a number of kites attached at various heights t common line, making a "kite train." Benjamin Fra famous (and dangerous) electricity experiment with handkerchief kite followed in 1752. These experime kites set the stage for many others to follow. By 182 Pocock constructed steerable kite trains with elaborate and lines, using them to propel a carriage – a Char-vo was able to carry four or five persons up to a speed of 2 per hour (32 km/hr). Many stories about Pocock's adv have been recorded, including races with kite-propelled b

No More Kite Lines

Between 1799 and 1809 George Cayley experimented with archtop kites. He became interested primarily in manned flight, dispensed with kite lines entirely, and concentrated on free-flight. His first craft consisted of two kites, a large one to provide lift and a smaller one for the tail, joined by a rigid frame. He experimented with control and steerage, and made calculations of how much weight various sizes of kites could lift. His work showed that lift and thrust were two different phenomena, dispelling any notion that wing flapping would get people airborne.

By 1853 Cayley had perfected his gliders sufficiently to attempt manned flight and persuaded his coachman to climb aboard his flying machine. This is the first record of manned flight of any appreciable distance.

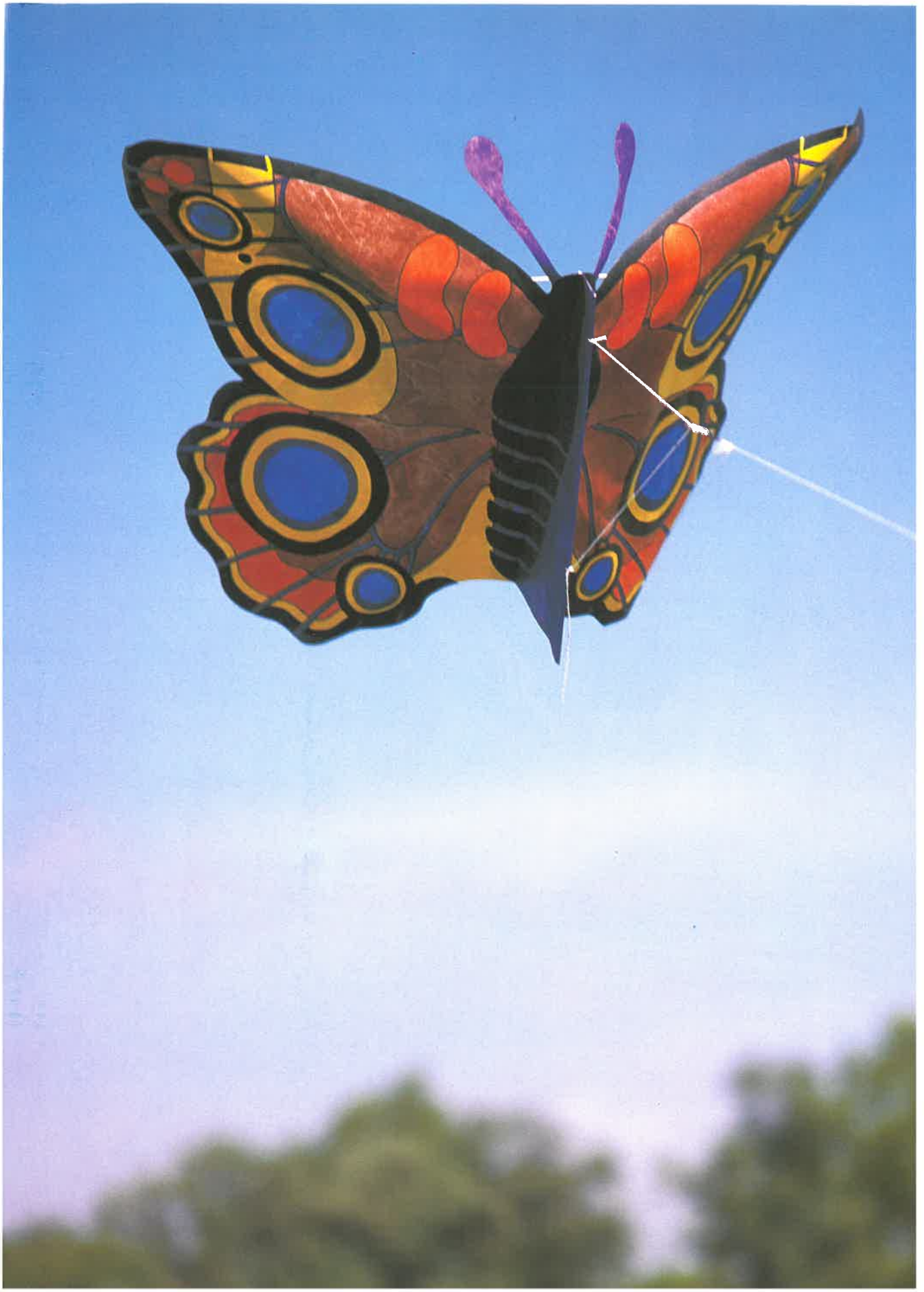
This pioneering work with kites laid the foundation for successful powered manned flight fifty years later.

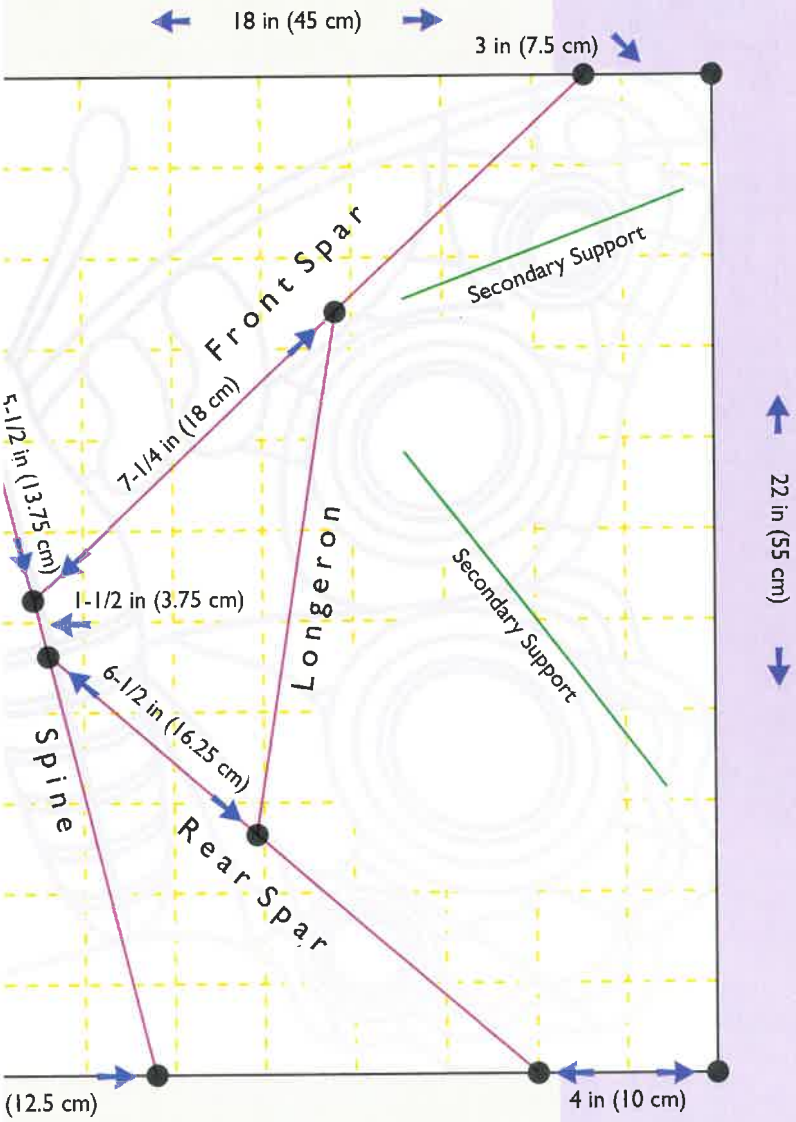


Buckeye

requires a Tyvek sheet size of
.2 in (90 cm x 55 cm).

ere is the sheet folded in half to
.2 in (45 cm x 55 cm), displaying the
nd side of the kite's face pattern. A 2 inch
rid is used to facilitate in transferring the
nto the Tyvek sheet (see p 12).





Buckeye Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

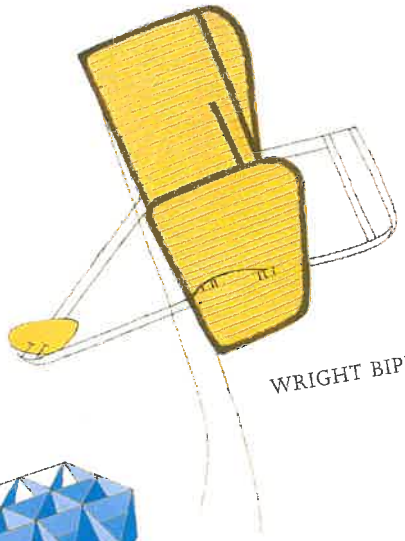
tion of framing materials

wood dowel – 1/8 in x 13-1/2 in (.3 cm x 33.8 cm)
port: 1 wood dowel – 1/8 in x 14 in (.3 cm x 35 cm)
ars: 2 wood dowels – 1/8 in x 15-1/2 in (.3 cm x 38.8 cm)
spars: none
rs: 2 wood dowels – 1/8 in x 13 in (.3 cm x 32.5 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 11 in (27.5 cm)
reader strut: 1 wood dowel – 1/8 in x 12 in (.3 cm x 30 cm)
eader strut: 1 wood dowel – 1/8 in x 6 in (.3 cm x 15 cm)
lene joiners: 8 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ry supports: 1/8 in wood dowels – 4 short pieces
g tabs: about 12 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

By 1847 work began on the first suspension bridge the 800 foot (240 m) Niagara gorge separating Canad United States. Some way was needed to lay the first cabl competition determined whose kite could cross the gorge kite carried the lines so that construction could proceed.

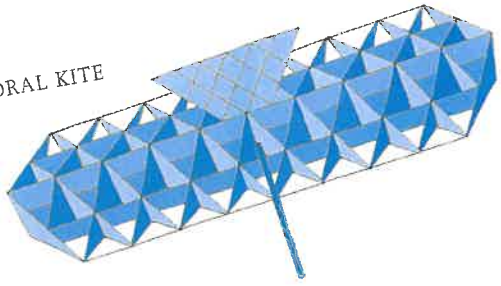
Kites from the "age of invention."

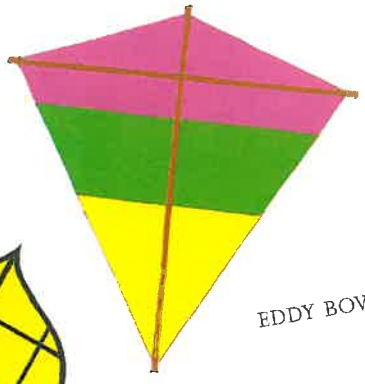
CODY WAR KITE



WRIGHT BIPLANE KITE

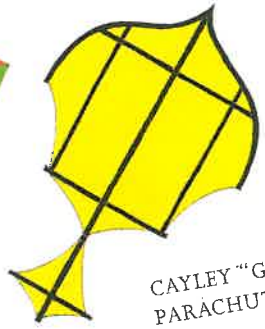
BELL TETRAHEDRAL KITE



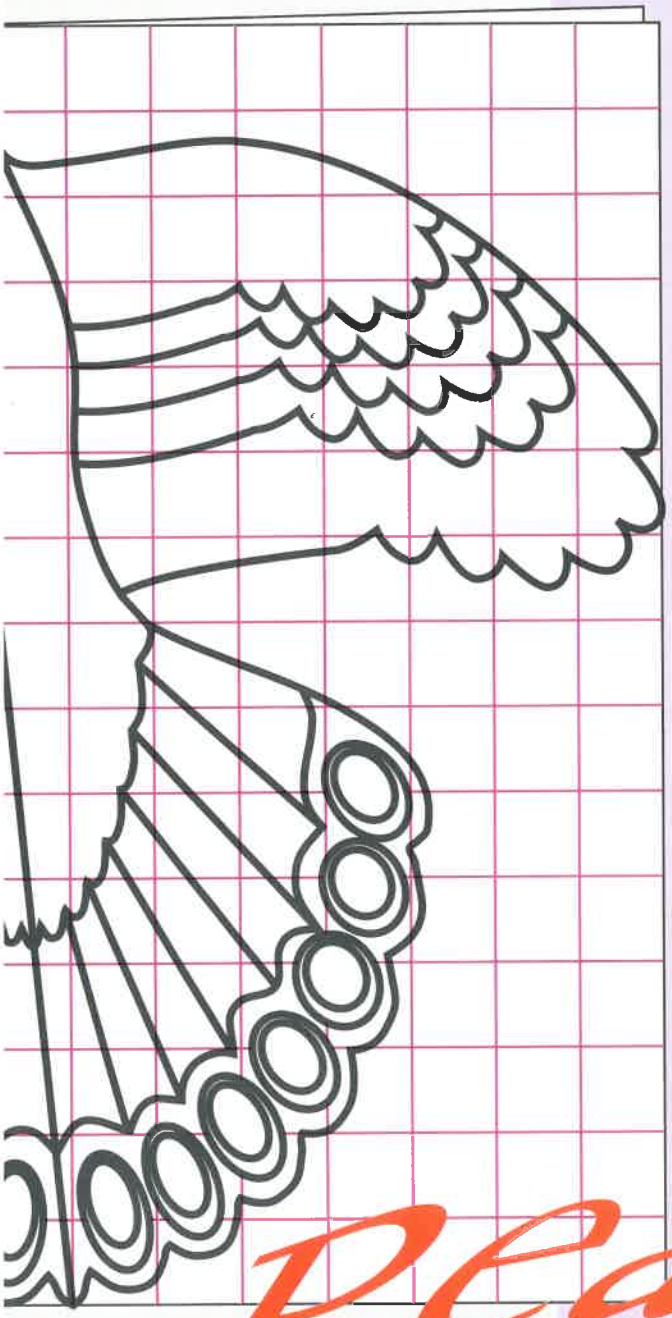


EDDY BOW KIT

HARGRAVE BOX KITE

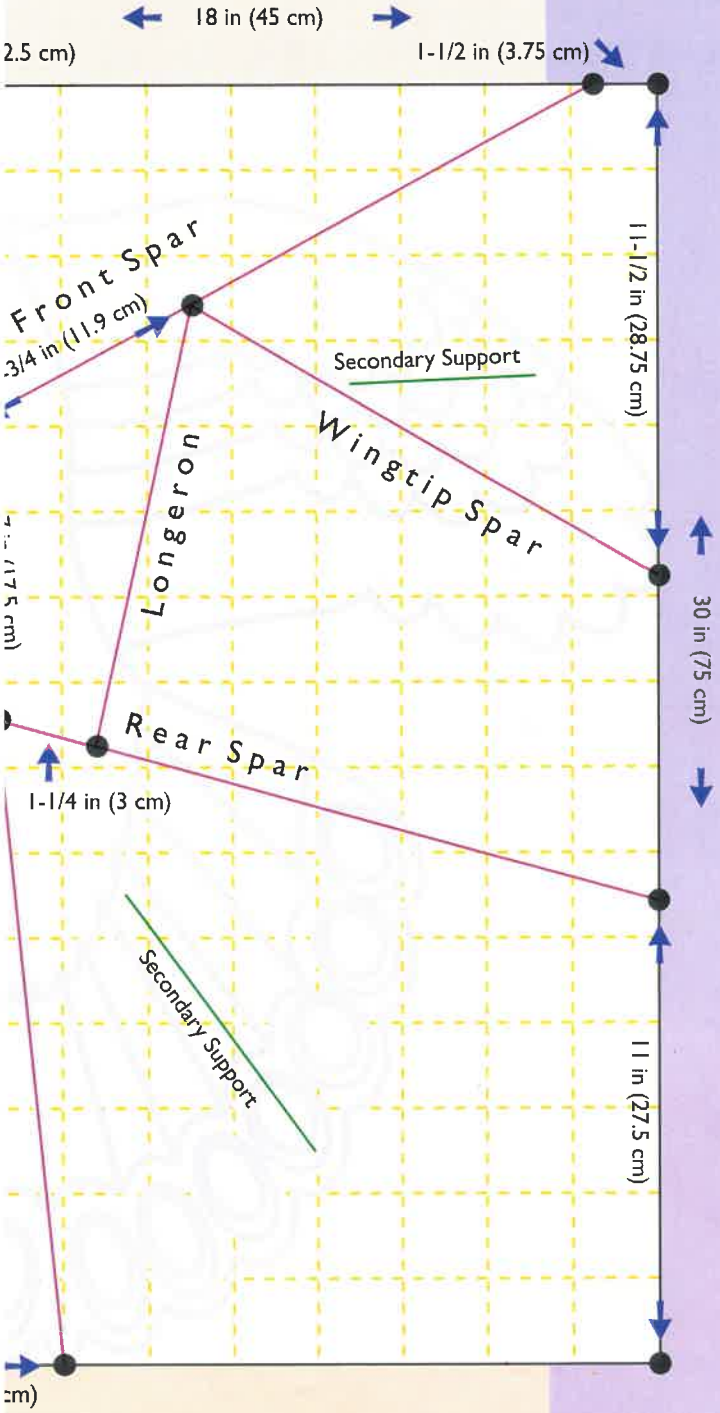


CAYLEY "GOVERNABLE PARACHUTE" KITE



This kite requires a Tyvek sheet size of 36 in x 30 in (90 cm x 75 cm).

Shown here is the sheet folded in half to 18 in x 30 in (45 cm x 75 cm), displaying the **righthand** side of the kite's face pattern. A 2 inch (5 cm) grid is used to facilitate in transferring the pattern onto the Tyvek sheet (see p 12).



Peacock Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

Description of framing materials

Spine: 1 wood dowel –
3/16 in x 30 in (.45 cm x 75 cm)
Keel support: 1 wood dowel –
1/8 in x 29 in (.3 cm x 72.5 cm)
Front spars: 2 wood dowels –
3/16 in x 9-1/2 in (.45 cm x 23.75 cm)
Wingtip spars: 2 wood dowels –
1/8 in x 12-1/2 in (.3 cm x 31.25 cm)
Rear spars: 2 wood dowels –
3/16 in x 9-1/2 in (.45 cm x 23.8 cm)
Longerons: 2 wood dowels –
measure and cut to fit,
approximately 9-1/2 in (23.8 cm)
Front spreader strut: 1 wood dowel –
3/16 in x 7-3/4 in (.45 cm x 19.4 cm)
Rear spreader strut: none
Polyethylene joiners: 8 pieces –
3/16 in (.45 cm) ID, x 1 in (2.5 cm),
notched in the middle
Secondary supports:
1/8 in wood dowels – 4 pieces
Fastening tabs:
about 15 pieces cut from scrap Tyvek,
approximately 1-1/2 x 3 in
(3.8 cm x 7.5 cm)

Kites were again used when the United States Weath
needed a reliable means of attaining upper-level atmosp
soundings. At first William Eddy experimented with la
hexagonal kites in trains of up to eighteen, but when th
unmanageable because of the massive tails required to g
stability, he created a tailless kite that became known a
Bow Kite. He attained stability by bowing the spar to f
dihedral angle and using a looser covering so that the cl
billowed inward between the outer frame and the spine,
keel. When Eddy finally got to see a Malaysian tailless
Columbian Exposition of 1893, he found that he had
out similar aerodynamics. In 1900 he pa
kite. It was used by the Weather Bureau u
replaced by Lawrence Hargrave's box kite, t
provided more lift and stability in the air.

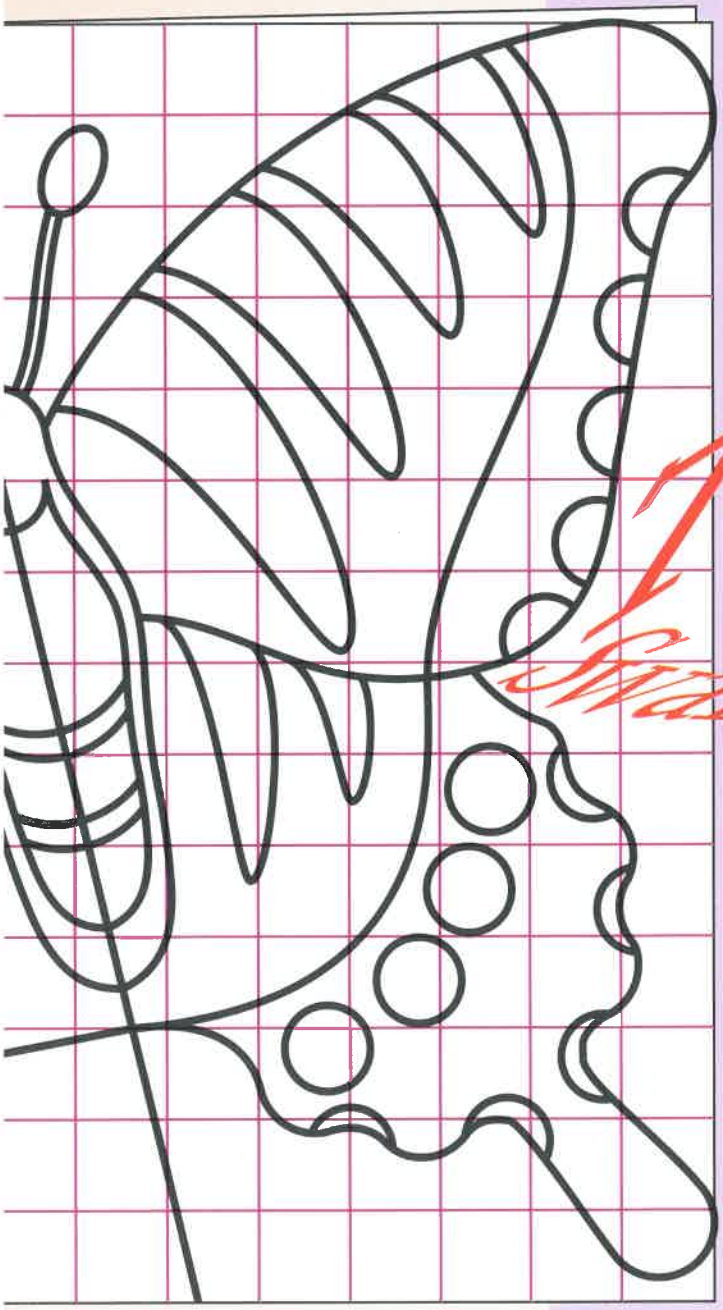
During the last decade of the nineteenth
and the first two decades of the twentieth cen
competitions encouraged people to experiment
capabilities and high altitude flight. In 1919
eight kites exceeded an altitude of 30,000 feet
(9,000 m) and large "man-lifting" kites turne
ship-to-shore rescue devices for vessels foundering
coastal rocks. During this time getting people airl
became an obsession and kites eventually turned i
airplanes. This was largely due to the aerodynamic
characteristics of Lawrence Hargrave's box kite. In
American inventors Orville and Wilbur Wright,
experimenting with biplane kites (derived from box
succeeded in sustained manned powered flight because
discovered how to stabilize and control a free-flying "k
they had an adequate engine. Thus the box kite became
biplane, the standard configuration of airplanes for man

Kites and airplanes

Australian Lawrence Hargrave discovered that a kite shaped like an open-ended box achieved great lift and stability from the double horizontal and vertical planes. He built a great number of variously shaped box kites and used them in his manned flight experiments. His "boxes" were flown less on lines as kites and increasingly as free-flying model gliders. His objective was to eventually develop a power driven airplane.

While successful manned flight eluded him, his experiments with the cellular configuration gave the world a great new kite—the stable Hargrave Box Kite.

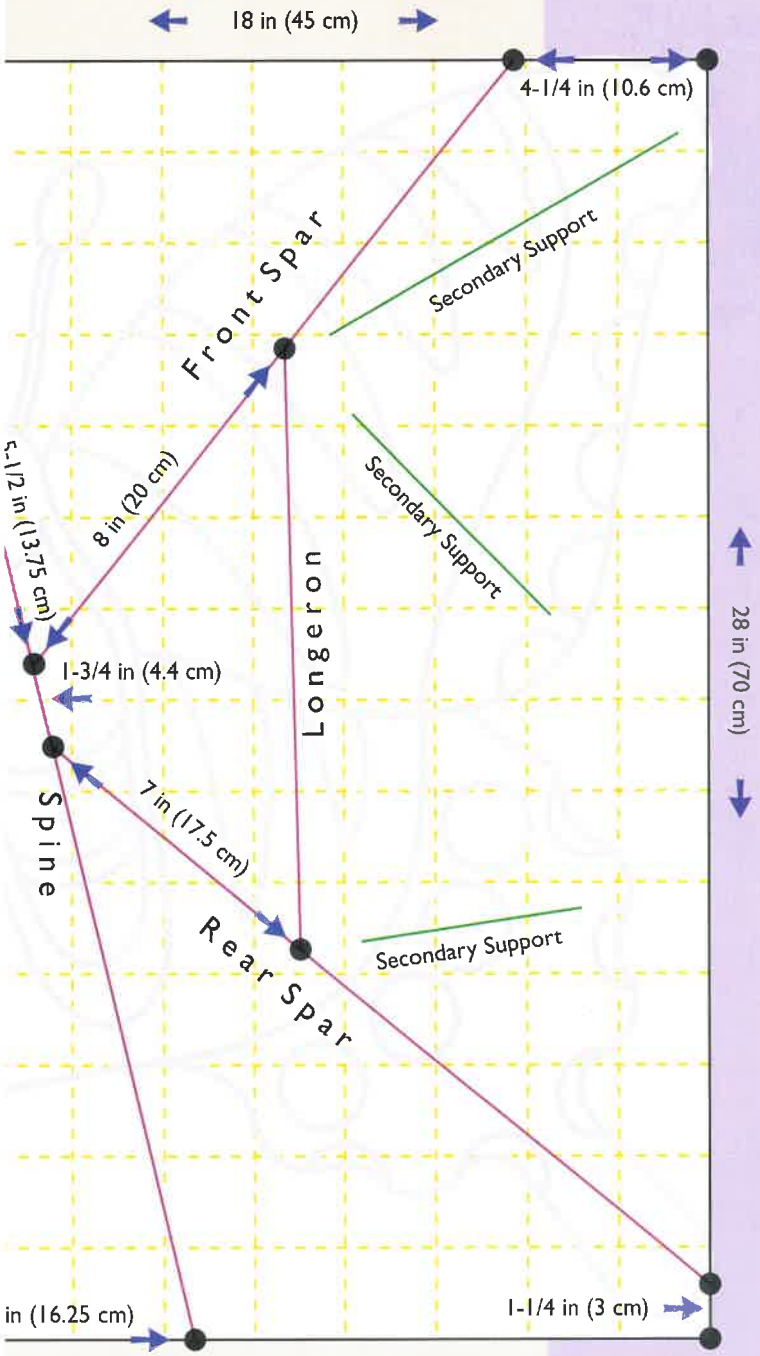
The box kite was used as the test vehicle for continued free-flight experiments around the world, becoming the basis for the first successful manned powered flight of Orville and Wilbur Wright in 1903. The box kite eventually evolved into the biplane, which proved to be a good airframe, and continues to be used to this day.



Tiger Swallowtail

This kite requires a Tyvek sheet size of 36 in x 28 in (90 cm x 70 cm).

Shown here is the sheet folded in half to 18 in x 28 in (45 cm x 70 cm), displaying the **righthand** side of the kite's face pattern. A 2 inch (5 cm) grid is used to facilitate in transferring the pattern onto the Tyvek sheet (see p 12).



Tiger Swallowtail Frame Layout

Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

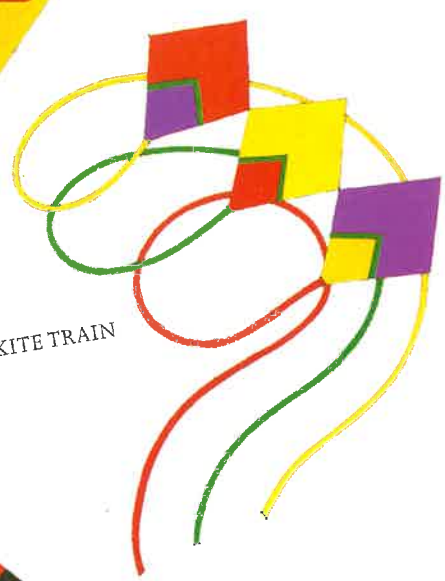
Description of framing materials

Spine: 1 wood dowel –
1/8 in x 14-1/2 in (.3 cm x 36.3 cm)
Keel support: 1 wood dowel –
1/8 in x 14-1/2 in (.3 cm x 36.3 cm)
Front spars: 2 wood dowels –
3/16 in x 16 in (.45 cm x 40 cm)
Wingtip spars: none
Rear spars: 2 wood dowels –
3/16 in x 18 in (.45 cm x 45 cm)
Longerons: 2 wood dowels –
measure and cut to fit,
approximately 12 in (30 cm)
Front spreader strut: 1 wood dowel –
3/16 in x 11-1/2 in (.45 cm x 28.75 cm)
Rear spreader strut: 1 wood dowel –
3/16 in x 7-1/2 in (.45 cm x 18.75 cm)
Polyethylene joiners: 8 pieces –
3/16 in (.45 cm) ID, x 1 in (2.5 cm),
notched in the middle
Secondary supports:
1/8 in wood dowels – 6 short pieces
Fastening tabs:
about 12 pieces cut from scrap Tyvek,
approximately 1-1/2 x 3 in
(3.8 cm x 7.5 cm)

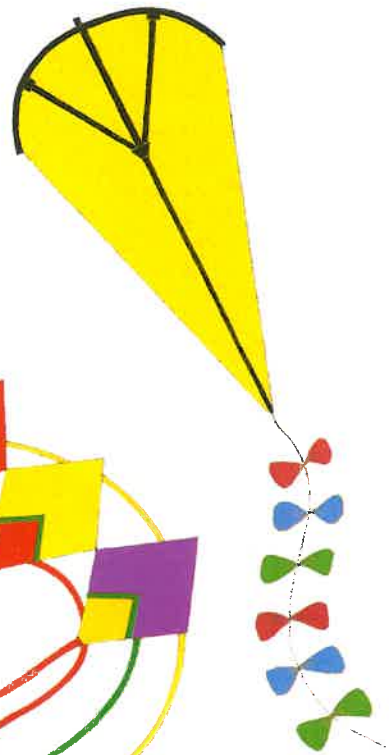
Around 1890 in England, inventor Samuel Cody in
the lift of a double-celled box kite by adding outrigger
making what is now called a compound kite. Besides su
that his kites be used in meteorological work, he propos
them as military observation platforms, equipping the o

Multiline maneuverable kites.

GARBER WWII TARGET KITE

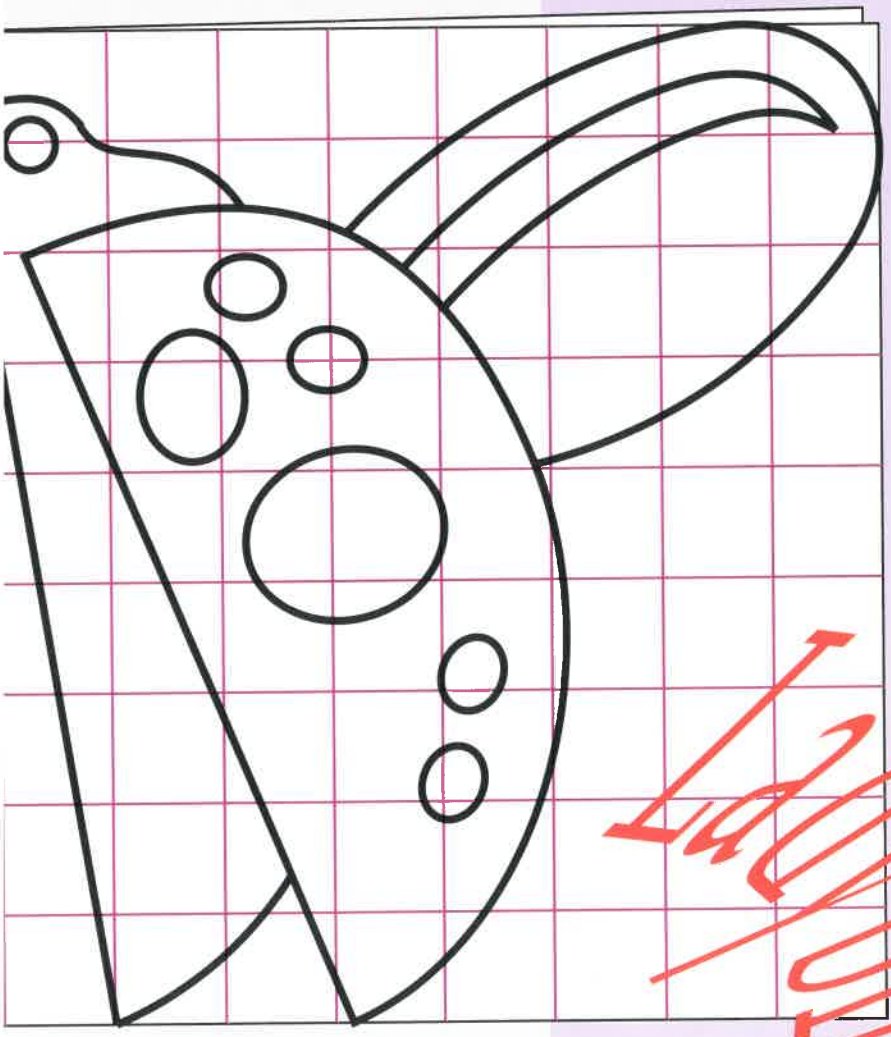


PETER POWELL STUNT KITE TRAIN



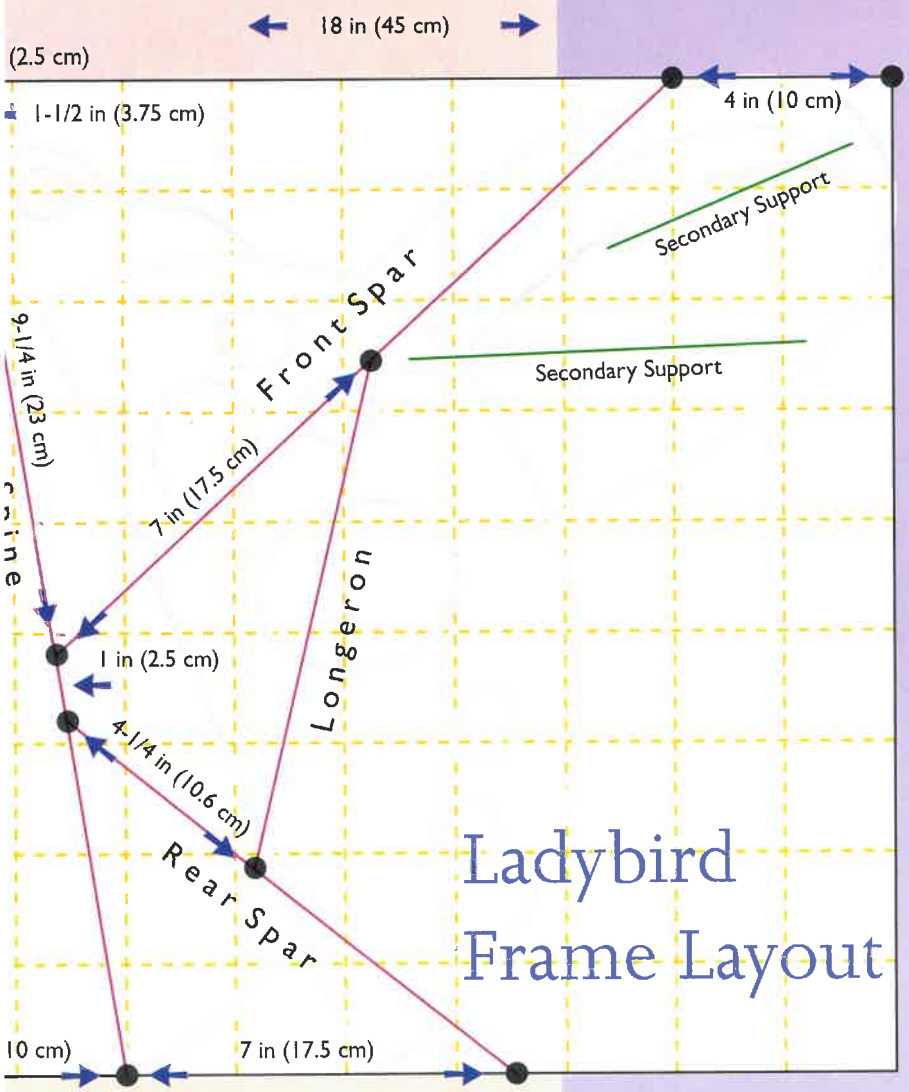
POCOCK ARCH-TOP KITE U
PROPEL HIS "CHAR-VOLAN

CONTEMPORARY STUNT KITE



requires a Tyvek sheet size of
8 in (90 cm x 45 cm).

ere is the sheet folded in half to
8 in (45 cm x 45 cm), displaying the
nd side of the kite's face pattern. A 2 inch
rid is used to facilitate in transferring the
nto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

tion of framing materials

wood dowel – 1/8 in x 17 in (.3 cm x 42.5 cm)
port: 1 wood dowel – 1/8 in x 16-1/2 in (.3 cm x 41.3 cm)
ars: 2 wood dowels – 1/8 in x 14 in (.3 cm x 35 cm)
spars: none
rs: 2 wood dowels – 1/8 in x 8-1/2 in (.3 cm x 21.3 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 8-1/2 in (21.3 cm)
reader strut: 1 wood dowel – 1/8 in x 10-1/2 in (.3 cm x 26.3 cm)
eader strut: none
lene joiners: 6 pieces – 1/8 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
ry supports: 1/8 in wood dowels – 4 pieces
g tabs: about 20 pieces cut from scrap Tyvek, approximately 1-1/4 x 2 in (3 cm x 5 cm)

(who sat in a wicker basket) with a telescope, camera, t
and rifle. This large "man-lifter," the most famous of his
was known as the Cody War Kite. The British military
sanctioned them in 1904. Cody continued his experime
was the first person in Britain – as the Wrights were in
United States – to build and fly a manned powered airp
(1908), literally by putting an engine and propeller on
kite.

Later, compound kites, called Brookites were made an
distributed worldwide by Walter and Thomas Brook.

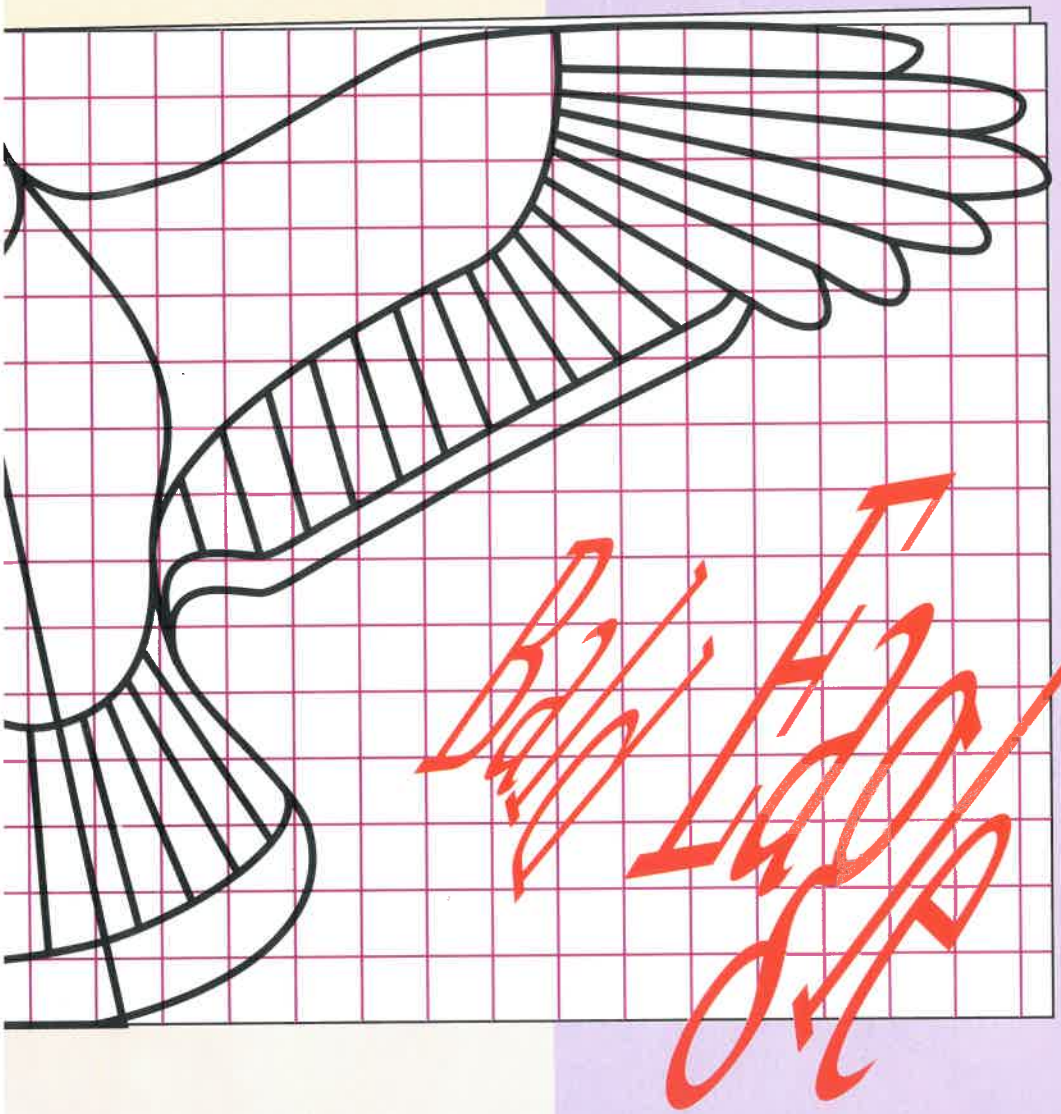
In Canada, British emigré Alexander Graham Bell, b
avid kiter. Like Hargrave, the Wrights, and Cody, he was
interested in manned flight and recognized the advantage
cellular construction. Unlike them, however, he based the
of his cell unit on the tetrahedral instead of the rectangle
of its inherent triangular strength.

Taking the cell concept to the extreme, he built mult
tetrahedral kites having as many as 3000 cells. While
celled airplanes never achieved great airworthiness be
inadequate engines, his multicelled kites were specta
His interest in manned flight prompted him to fo
Aerial Experiment Association, that included the
American motorcycle builder and racer Glen C
specifically to develop engines for flight. A pow
engine resulted, but was never fitted to a tet
craft. After this association disbanded in 1
Curtiss, because of his knowledge of engi
went on to rival the Wrights in develop
airplane into a reliable machine.

The kite and radio

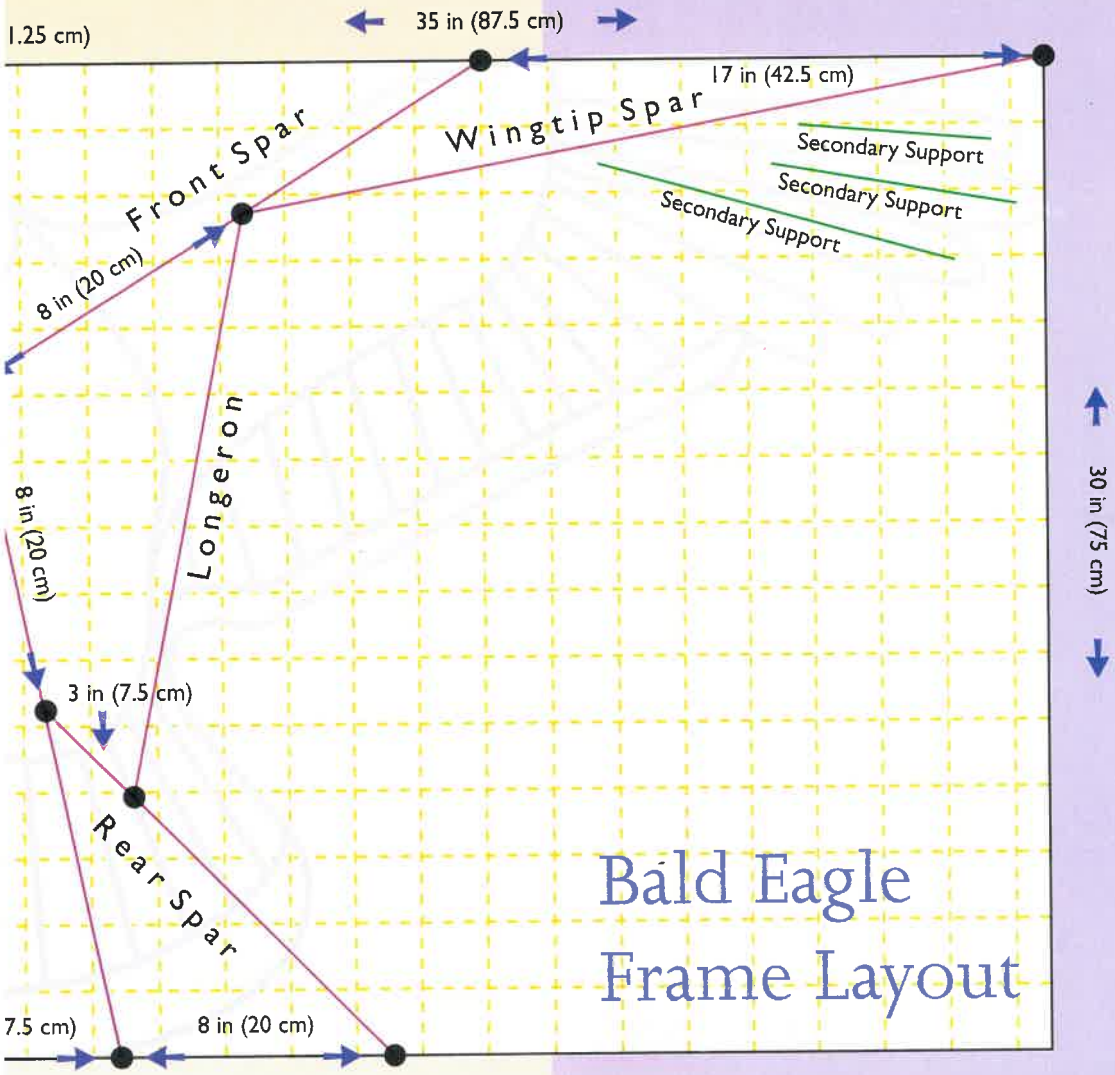
B.F.S. Baden-Powell, of the Scots Guards, realized the advantages that kites could give to the military as aerial observation platforms. But his experimental hexagonal levitor was never perfected and was never used for this purpose.

The Levitor did gain some notoriety in connection with the radio's development by Guglielmo Marconi. A Levitor kite was used to raise the radio's large aerial for Marconi's first trans-Atlantic radio transmission from Cornwall to Newfoundland in 1901. However, the kite's instability almost prevented the success of the transmission because of the aerial's erratic movement.



requires a Tyvek sheet size of
0 in (175 cm x 75 cm). See p 12.

ere is the sheet folded in half to
0 in (87.5 cm x 75 cm), displaying the
nd side of the kite's face pattern. A 2 inch
rid is used to facilitate in transferring the
nto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

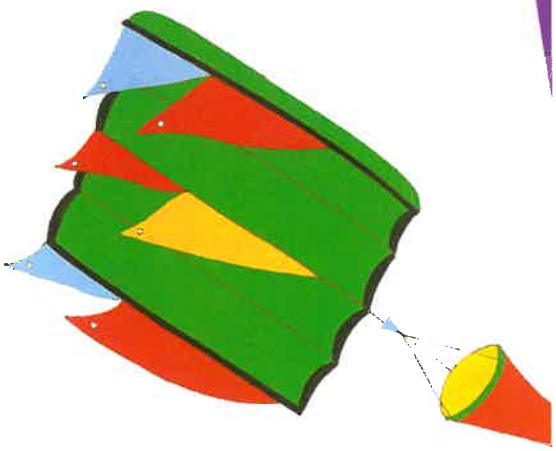
tion of framing materials

vood dowel – 1/4 in x 30 in (.6 cm x 75 cm)
ort: 1 wood dowel – 1/8 in x 30 in (.3 cm x 75 cm)
rs: 2 wood dowels – 1/4 in x 16 in (.6 cm x 40 cm)
spars: 2 wood dowels – 3/16 in x 22-1/2 in (.45 cm x 56.3 cm)
s: 2 wood dowels – 1/4 in x 10 in (.6 cm x 25 cm)
is: 2 wood dowels – measure and cut to fit, approximately 14-3/4 in (36.9 cm)
eader strut: 1 wood dowel – 1/4 in x 13-1/2 in (.6 cm x 33.8 cm)
ader strut: none
ene joiners: 6 pieces – 1/4 in (.3 cm) ID, x 3/4 in (2 cm), notched in the middle
y supports: 1/8 in wood dowels – 6 pieces
tabs: about 28 pieces cut from scrap Tyvek, approximately 1-3/4 x 3 in (4.5 cm x 7.5 cm)

Between the two world wars, the kite was superseded scientific and practical applications by other machines again became an object of enjoyment for ordinary peopl even though new kite designs were invented, the recreati of kites was not widely pursued outside the Orient.

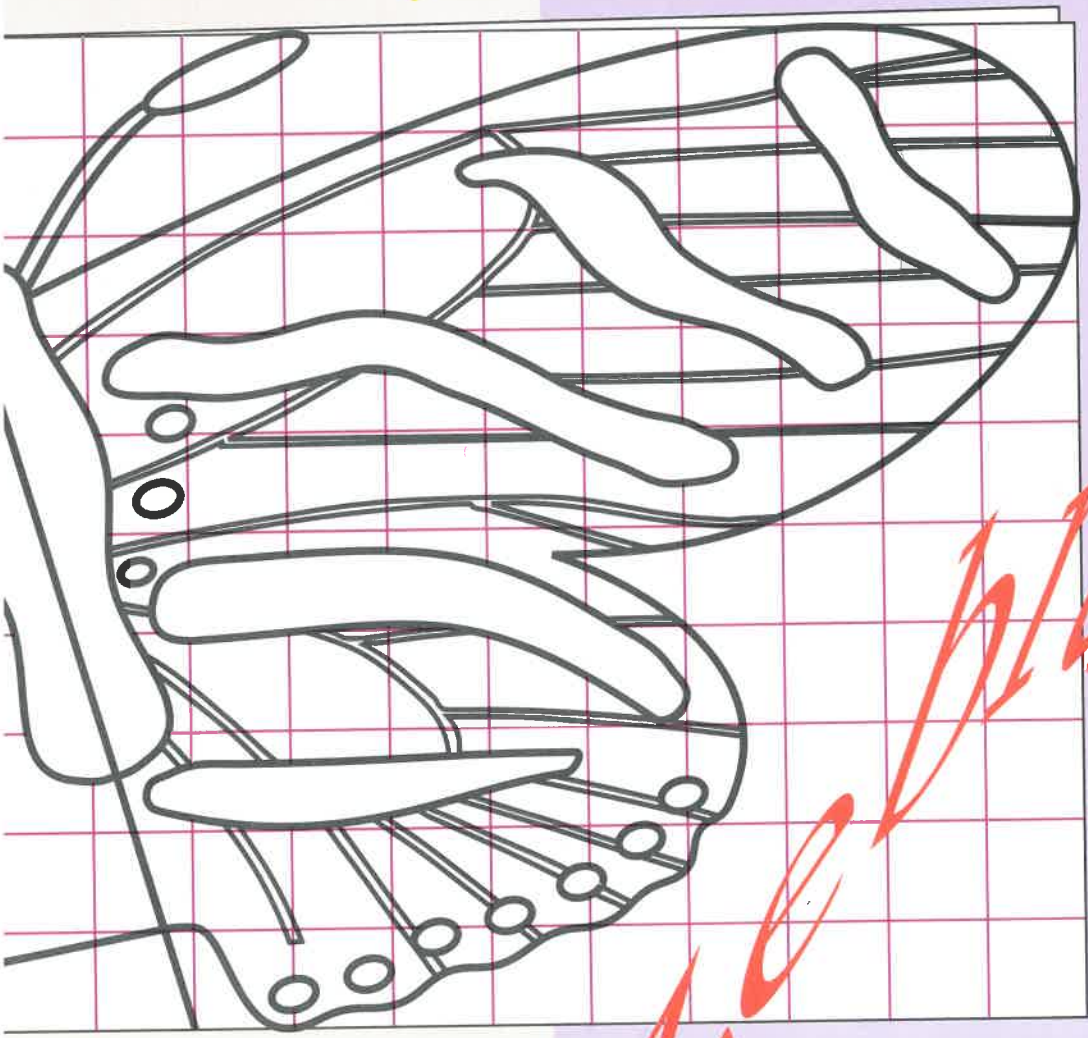
Twentieth-century kite innovations.

ROGALLO FLEXIBLE DELTA KITE



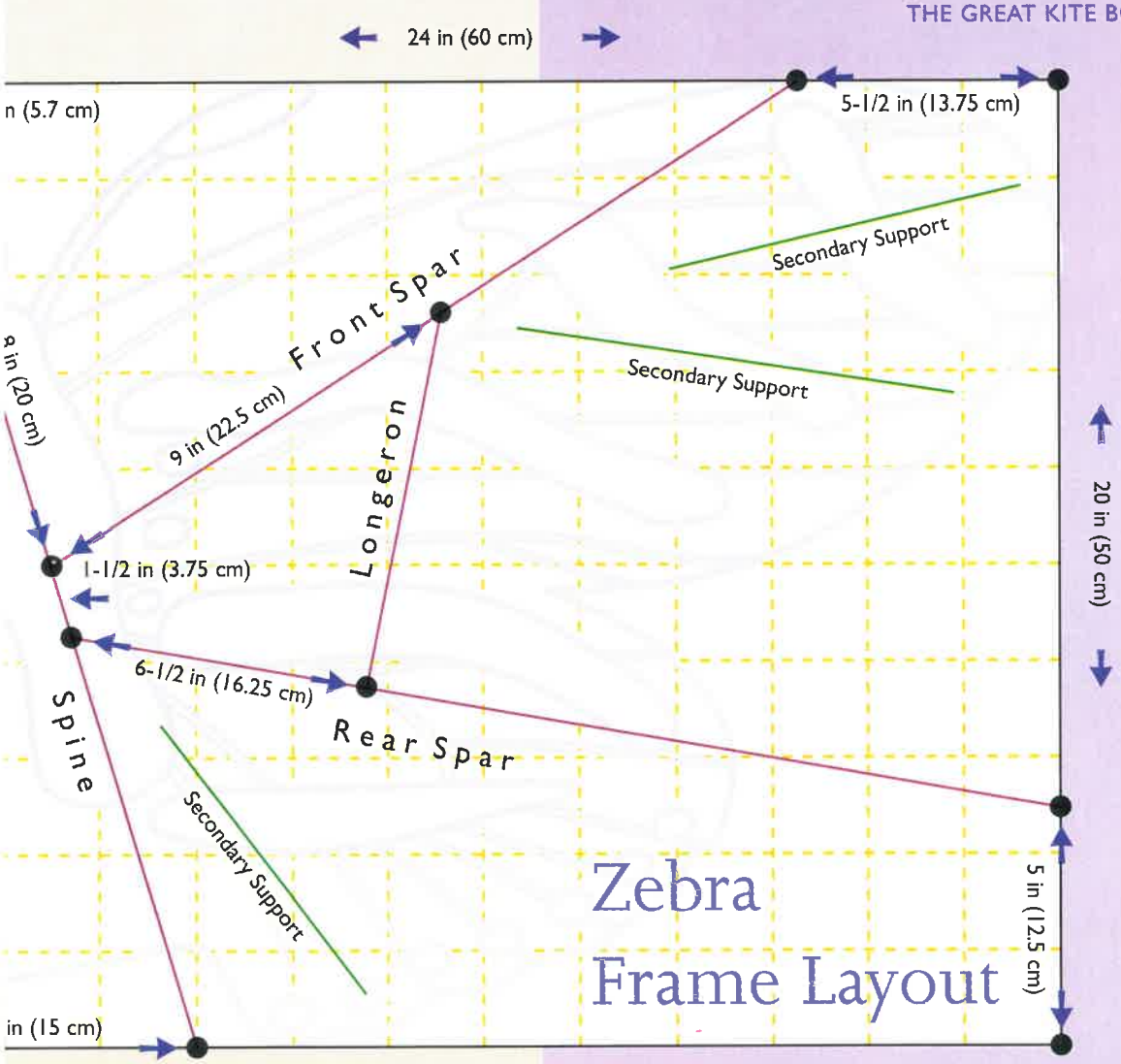
JALBERT PARAFOIL KITE

SCOTT/GRAUL SLED KITE



requires a Tyvek sheet size of
:0 in (120 cm x 50 cm). See p 12.

ere is the sheet folded in half to
:0 in (60 cm x 50 cm), displaying the
nd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
onto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

tion of framing materials

wood dowel – 3/16 in x 16 in (.45 cm x 40 cm)
port: 1 wood dowel – 1/8 in x 16 in (.3 cm x 40 cm)
ars: 2 wood dowels – 3/16 in x 18 in (.45 cm x 45 cm)
spars: none
rs: 2 wood dowels – 3/16 in x 13 in (.45 cm x 32.5 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 7 in (17.5 cm)
reader strut: 1 wood dowel – 3/16 in x 15 in (.45 cm x 37.5 cm)
eader strut: none
lene joiners: 6 pieces – 3/16 in (.3 cm) ID, x 1 in (2.5 cm), notched in the middle
y supports: 1/8 in wood dowels – 6 pieces
g tabs: about 24 pieces cut from scrap Tyvek, approximately 1-1/2 x 3 in (3.8 cm x 7.5 cm)

Kites for everyone

Interestingly, long after kites had influenced airplane de and airplanes had achieved incredible advances, the airp influenced a new development in kites. In 1948 Francis an American aeronautical engineer interested in spacecr developed a delta-shaped fabric wing having no rigid sp kind. It could be stowed folded into a small space when use, and deployed like a parachute when needed, taking s only when the flow of air billowed it out against the counterbalancing support of numerous shroud lines. Alth used in spacecraft re-entry, the flexible delta wing (with addition of some rigid supports) has become the favorit design for many enthusiasts.

Its creation also led to further experiments by othe influencing two additional developments. One was the originally developed by William Allison in the 1950 modified by Frank Scott and Ed Grauel. The other w parafoil, created by Domina Jalbert in the 1960s.

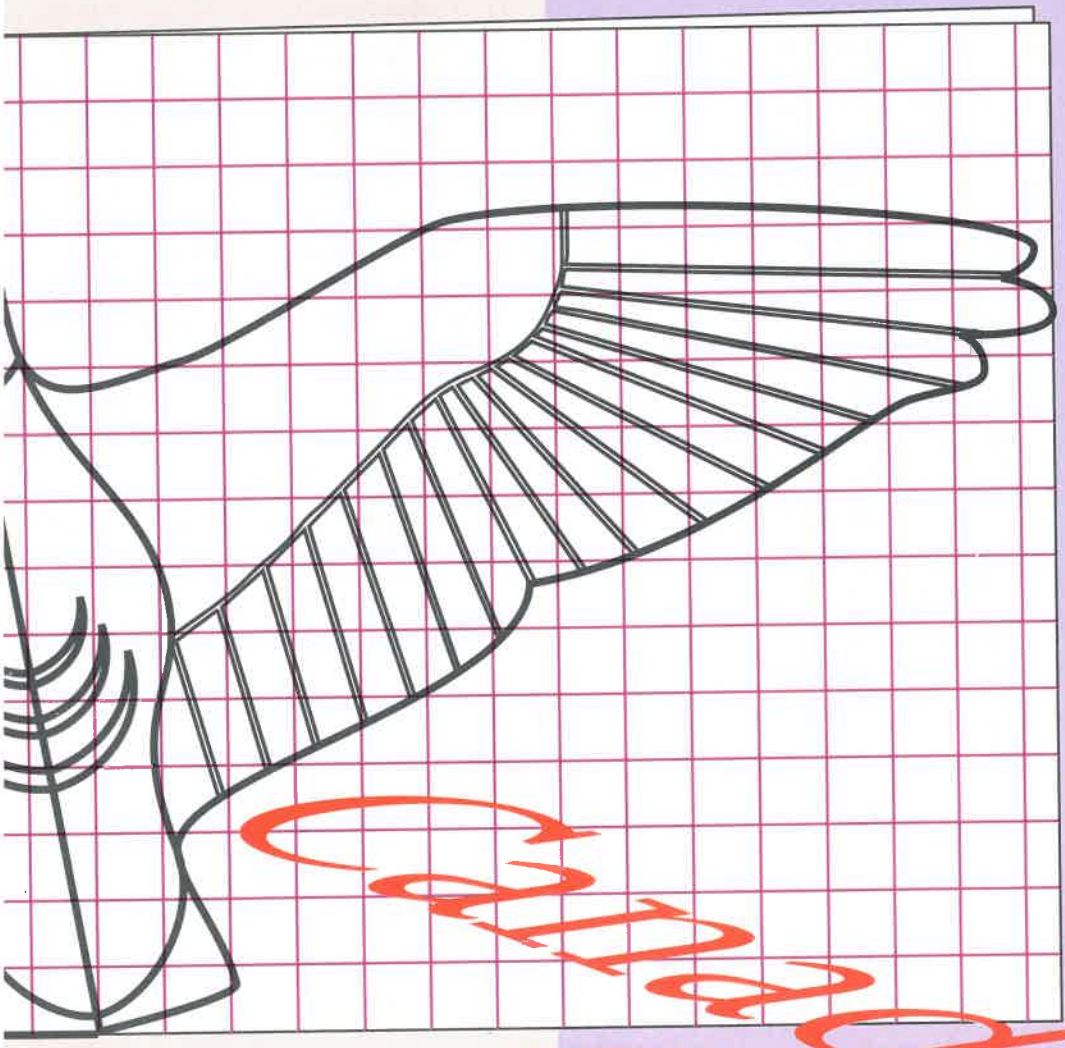
During the second world war, naval officer Paul introduced a technique to control kites similar to extra lines method first used by George Pocock in He applied it to a modified Eddy Bow Kite, mad two industrial materials – an aluminum frame rayon sail. The kite could mimic aerial combat maneuvers and was used as a realistic target fo gunnery practice.

Many innovations in kite design and materials in 1970s and 80s, especially in aerobatic kites, led to incre popularity of kiting. Will Yolen promoted the art of kiting American sculptor, Tal Streeter, who applied traditional Ja

Kites and parachutes

Domina Jalbert realized that a conventional parachute was inefficient because it spilled a lot of air, and was dangerous because it offered limited maneuverability to the descending flier. His parafoil kite was much more buoyant because of how its multicelled configuration trapped air. He realized that it could easily be adapted for use as a parachute. It was very maneuverable because of its keel and bridle system, making controlled descents and pin-point landings possible.

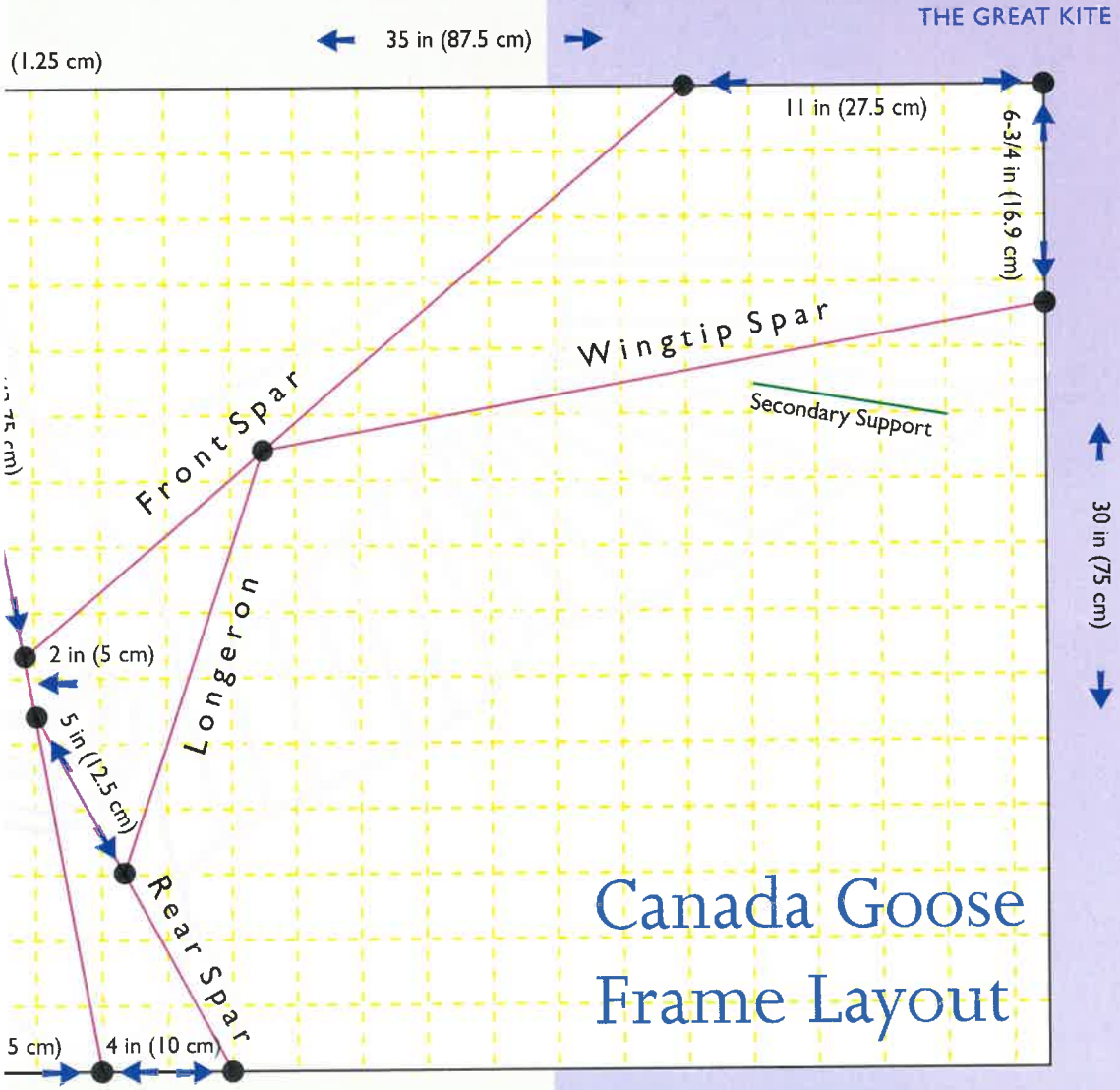
This makes the parafoil ideal for military applications, enabling a pilot who has bailed out to exercise considerable evasive maneuvering. It is also widely used for controlled aerial display jumping.



Canada Goose

: requires a Tyvek sheet size of
30 in (175 cm x 75 cm). See p 12.

ıere is the sheet folded in half to
30 in (87.5 cm x 75 cm), displaying the
ınd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
ɔnto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

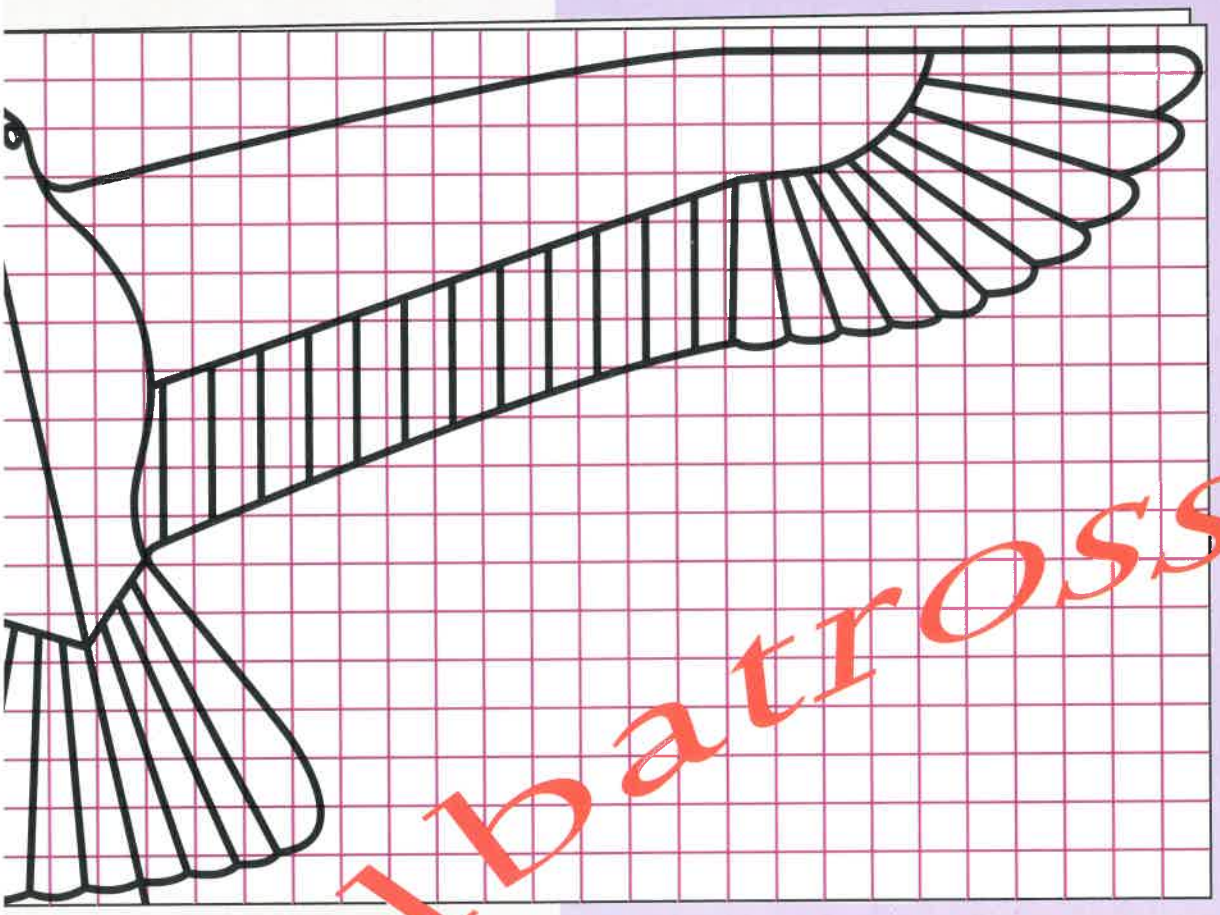
otion of framing materials

wood dowel – 1/4 in x 30 in (.6 cm x 75 cm)
port: 1 wood dowel – 1/8 in x 30 in (.3 cm x 75 cm)
ars: 2 wood dowels – 1/4 in x 17-1/2 in (.6 cm x 43.8 cm)
spars: 2 wood dowels – 3/16 in x 24 in (.45 cm x 60 cm)
rs: 2 wood dowels – 1/4 in x 10 in (.6 cm x 25 cm)
ns: 2 wood dowels – measure and cut to fit, approximately 13 in (32.5 cm)
reader strut: 1 wood dowel – 1/4 in x 14 in (.6 cm x 35 cm)
eader strut: none
lene joiners: 6 pieces – 1/4 in (.6 cm) ID, x 1 in (2.5 cm), notched in the middle
ry supports: 1/8 in wood dowels – 2 pieces
g tabs: about 20 pieces cut from scrap Tyvek, approximately 1-3/4 x 3 in (4.5 cm x 7.5 cm)

kite techniques to his aerial artwork, raised the kite's st
North America to objet d'art. In Japan, Dr. Toshi Ito an
Hirotsugu Komura, brought scientific investigation to ki
aerodynamics for its own sake. Kiting, once popular only
oriental cultures, is today providing fun and satisfaction
enthusiasts in North America, Europe, and the rest of th

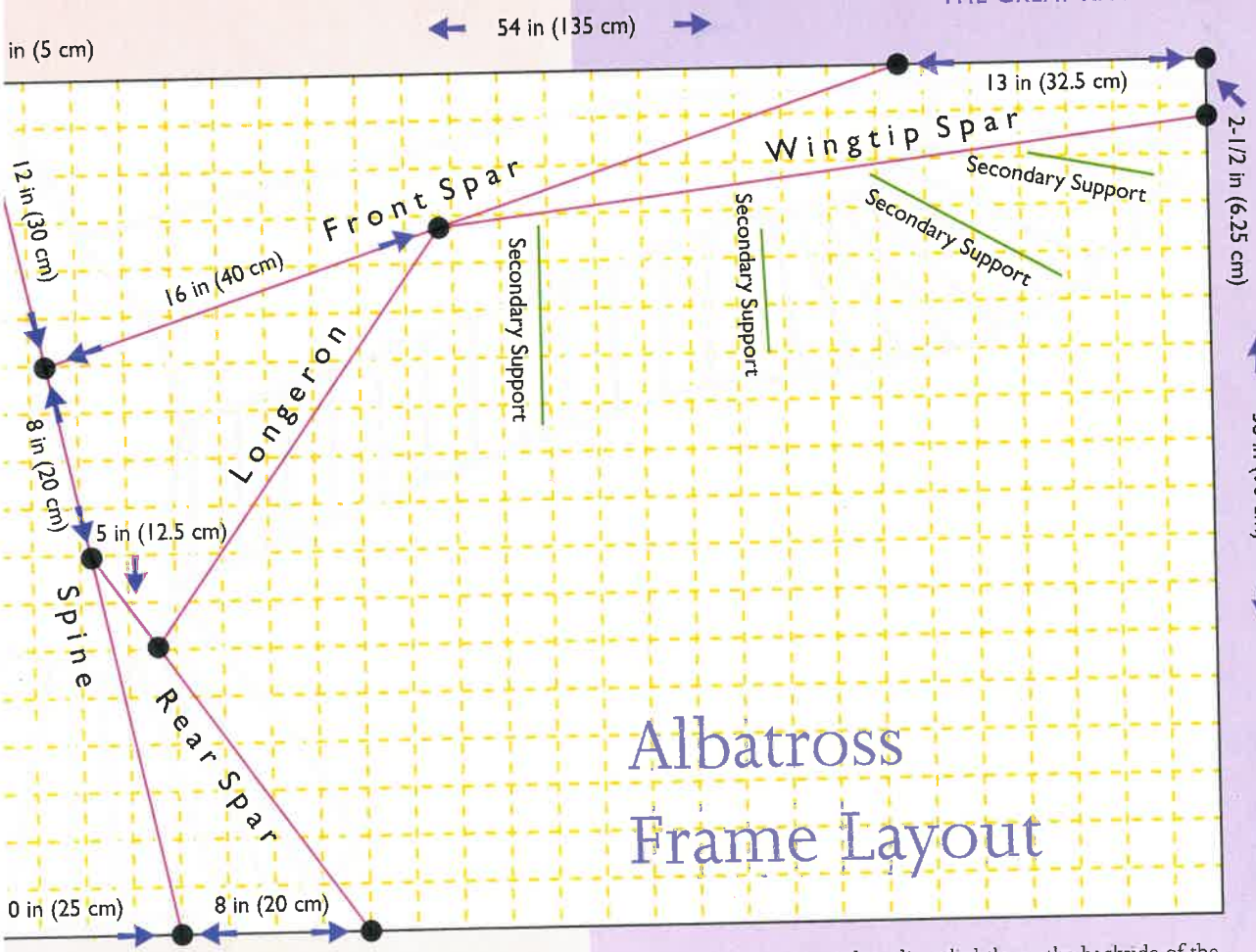
Airborne art

American sculptor, Tal Streeter, was particularily interested in art objects that led the eye away from the object itself into the adjoining space. In the 1960s he worked primarily in metal, erecting large-scale environmental pieces. Realizing that the verticality of some of his artwork directed the viewer's gaze skyward, he became interested in placing objects in the sky itself. This led him to the world of kites, and for a number of years he lived in Japan to study traditional kite-making techniques from the old masters. His artistic expressions, once heavy and rooted in the ground, became airborne. His work reflects much of the simple beauty of the Japanese culture that inspired it. Streeter's notion of kite-as-an-art-object has done a great deal to raise the kite's status in North America.



: requires a Tyvek sheet size of
: 36 in (270 cm x 90 cm). See p 12.

ıere is the sheet folded in half to
36 in (135 cm x 90 cm), displaying the
ınd side of the kite's face pattern. A 2 inch
grid is used to facilitate in transferring the
ɔnto the Tyvek sheet (see p 12).



Draw these lines lightly on the backside of the sheet (see p 13 step 4).
Mark joiner positions directly on the spar dowels for greater accuracy (see p 14 step 11).

cription of framing materials

e: 1 wood dowel – 1/4 in x 36 in (.6 cm x 90 cm)
support: 1 wood dowel – 1/4 in x 36 in (.6 cm x 90 cm)
ıt spars: 2 wood dowels – 1/4 in x 32 in (.6 cm x 80 cm)
.gtip spars: 2 wood dowels – 1/4 in x 33 in (.6 cm x 82.5 cm)
: spars: 2 wood dowels – 1/4 in x 17 in (.6 cm x 42.5 cm)
gerons: 2 wood dowels – 1/4 in (.6 cm) x measure and cut to fit, approximately 20 in (50 cm)
ıt spreader strut: 1 wood dowel – 1/4 in x 30-1/2 in (.6 cm x 76.3 cm)
r spreader strut: none
'ethylene joiners: 6 pieces – 1/4 in (.6 cm) ID, x 1 in (2.5 cm), notched in the middle
ondary supports: 1/8 in wood dowels – 8 pieces
ening tabs: about 34 pieces cut from scrap Tyvek, approximately 1-3/4 x 3 in (4.5 cm x 7.5 cm)

Index

acrylics, 11
aerobatic kites, 4
aerodynamic principles, 4
air foil, 5
air frame, 7
air pressure, 5
albatross kite, 92, 93, 94
Allison, William, 87
aluminum frame, 87
anchor hitch, 8
angle of attack, 4, 5, 6
arc, 4, 5
archtop fighter kite, 63, 75
aspect ratio, 4, 5, 6

Baden-Powell, B.F.S.,79
Bald Eagle kite, 80, 81, 82
Bali, 43
bamboo kites, 23
Barn Swallow kite, 36, 37, 38
Bat kite, 28, 29, 30
Bell, Alexander Graham, 79
bird kite, 27
box kites, 4
bridge-spanning kite, 67
bridle, 7,8,9,16
Buckeye kite, 64, 65, 66
Buddhist monks, 23
Bumble Bee kite, 32, 33, 34

cambered wing, 5
Canada Goose kite, 88, 89, 90
Caribbean Islands, 55
carp windsock, 35, 39
Cayley, George, 63
Cayley parachute kite, 67
center of drag, 5
center of gravity, 5
center of lift, 5
center of pressure, 5
char-volant, 63, 75
Children's Day festival, 35
Chinese Kite Day, 23
Chinese kites, 3, 23, 27
chula kite, 43, 47
Cody war kite, 67, 79
contemporary stunt kite, 75
convex leading edge, 6
Curtiss, Glen, 79
Cultural Revolution, 23

diamond kite, 47, 59
dihedral angle, 6, 7
dowels, 11, 14, 16
drag, 4, 5
Dragonfly kite, 44, 45, 46
dragon kite, 27
dragon windsock, 59
drogue, 7,8

Edo kite, 39
Edo period, 31, 35
Eddy bow kite, 67, 87
efficiency, 4, 5, 6
equilibrium, 7
European draco kite, 59
European kites, 59, 63

Falcon kite, 60, 61, 62
felt markers, 11
fertility kite, 27, 43
figure kite, 27
Firefly kite, 56, 57, 58
fishing kite, 47
flex-frame kite, 10, 83
flying line, 5, 9, 10
frame joiners, 14, 15
Franklin, Benjamin, 63

Garber, Paul, 87
Garber WWII target kite, 75
glazed tissue paper, 35
gliders, 63
glue, 16
gravity, 4

handkerchief kite, 63
Hargrave box kite, 67, 71
Hargrave, Lawrence, 71, 79
hexagonal levitor kite, 79
"high start," 9
human flight, 3

India, 47, 51
Indian fighter kite, 47
induced drag, 5
industry and technology, 3
insect kite, 27
instructions, 12
Ito, Dr. Toshio, 11, 91

Jalbert, Domina, 87
Jalbert parafoil kite, 83
Japan, 23, 27, 31, 35, 39, 87, 91
joiners, 14, 15, 16

kabuki theater, 31
keel, 6, 7, 15, 16
keel fold, 13
kite basics, 4
kite building instructions, 12
kite fighting, 43, 51, 55
kite materials, 3
kite painting, 13
kite parts, 11
kite-propelled boat, 63
kite-propelled carriage, 63
kite train, 63
Korea, 35, 39
Korean fighter kite, 39

Ladybird kite, 76, 77, 78
lark's head hitch, 8
lift, 4, 5
lift-to-drag ratio, 4, 5
longerons, 15, 16

man-lifter kite, 79
manned flight, 63, 71, 79
Mao Tse Tung, 23
Marco Polo, 63
Maori bird-man kite, 47
Maori manu kite, 43
Malay diamond kite, 63
Malay wau kite, 47
Malaysia, 35, 47,
Malaysian tailless kite, 71
Monarch kite, 40, 41, 42
Mourning Cloak kite, 52
mulberry leaves, 23
multicelled tetrahedral kite, 79
multiline kites, 75

Nagasaki hata kite, 35, 39
New Zealand, 43

o-dako kite, 31, 39
oriental kites, 10

pakpao kite, 43, 47
paper manufacture, 23
parachutes, 87
parafoil, 83
parasite drag, 5
parts of a kite, 11
pattern transfer, 12
Peacock kite, 68, 69, 70
pennon kite, 59
plain kite, 20, 21, 22
Pocock, George, 63, 75
polyethylene tubing, 11, 14
Polynesia, 43
Polynesian kite, 43
Powell, Peter, stunt kite train, 75
pull tabs, 16, 17

rayon sail, 87
Red Admiral kite, 24, 25, 26
Rogallo Flexible Delta kite, 83
Rogallo Francis, 87
rokkaku kite, 31, 39
roll stability, 7
Roman dragon windsocks, 55

sail, 5, 6, 9
Samuri warriors, 35
Scott/Graul, 87
Scott-Graul sled kite, 83
Seagull kite, 48, 49, 50
secondary supports, 16
shop equipment, 11
shroud, 8
silkworm culture, 23
simple kites, 3
sled kite, 83
South Sea Island kite
spacecraft, 87
spars, 7, 10, 14, 15,
spin, 7, 14
spinner, 8
spreader stunt, 15, 1
stability, 4, 6, 8
Streeter, Tal, 87, 91
string, 11
stylized kite art, 10
sun kites, 55
swivel hooks, 11

tabs, 14, 15, 16
tail, 6, 7, 15, 16
Tang dynasty, 23
target kites, 87
tether, 4
Thailand, 43, 47
Tiger Swallowtail kit 73, 74
towing point, 8
towing rings, 11
tukkal kite, 47, 55
Tyvek™, 10, 11, 12, 28, 32,36, 40, 44, 56, 60, 64, 68, 72, 84, 88, 92

United States Weathe Bureau, 71

wan-wan kite, 31
western kites, 3, 10
Wilson, Alexander, 6
wind, 4
wind gradient, 4, 9
wind scale, 4
wind shadow, 4
wood block printing
Wright biplane kite,
Wright, Orville and 71, 79

yaw stability, 7
Yolen, Will, 87

Zebra kite, 84, 85, 8
zenith, 7

ıry

attack The angle of a kite as it faces the wind, higher at the leading-edge, :he tail end.

lift-producing plane (as in an airplane wing) having a curved upper ıd a less curved lower surface, which creates a pressure differential above ath it.

tio The relationship between a kite's width (span from wingtip to wingtip) ngth (chord length from front to back). A square kite has a ratio of one.

e The loop of line fastened to the spine (or keel) of a kite, to which is the towing ring and flying line, and is used to adjust the angle of attack.

angle The upward slanting of the sail away from the spine to the wingtips.

A cone-shaped fabric tube fastened to the lower end of a kite's spine by a ting drag directly behind the kite, lending stability.

ıe A long length of line, stored on a reel, having one end attached to a kite's ng, allowing the kite to rise into the air. A kite's tether.

t A method of launching a kite where one person operates the flying line retched out, and another person holds the kite, releasing it into the air as tor puts tension on the line.

length of polyethylene tubing, notched in the middle, used to fasten wood ›gether.

vertical surface of a kite, providing yaw stability.

ı A framing piece that runs roughly from front to back.

tation around a kite's lateral axis.

ıtion along the length of a kite.

e's wind-receiving covering.

aming piece that runs roughly crosswise from the spine outward.

:entral framing piece that runs front to back, dividing the kite into two ves.

A cone-shaped fabric tube that spins, made up of a number of triangles and ımerous decorative streamers. It is fastened to the lower end of a kite's a line so that the drag it creates is directly behind the kite. It stabilizes as :corates a kite.

:aming piece that supports a kite's lefthand and righthand spars, providing l angle.

›ok A fastener having a safety clasp and swivel, allowing anything attached ıtate freely.

.all piece of material used to fasten framing pieces to the sail.

ıg-creating streamer or other appendage fastened to the lower end of a ıe so that its drag is directly behind the kite, lending stability.

oint The place on the bridle where the flying line is attached to give the orrect angle of attack.

ing The ring to which the flying line is fastened, used to adjust the angle of

dient The gradual increase of the speed of the wind with increasing height ground up.

dow The area downwind of an object where air, having passed over the turbulent.

:par A framing piece running roughly crosswise that supports the outer : a kite's sail.

ıtion around a kite's vertical axis.

Bibliography

Barwell, Eve, and Conrad Bailey. *How to Make and Fly Kites*. Studio Vista, London, 1972.

Evans, David. *Fishing for Angels: The Magic of Kites*. Annick, Toronto, 1991.

Hart, Clive. *Kites: An Historical Survey*. Praeger, New York, 1967.

Hart, Clive. *The Dream of Flight*. Faber, London, 1972.

Hosking, Wayne. *Kites*. Friedman/Fairfax, New York, 1994.

Ito, Dr. Toshio, and Hirotsugu Komura. *Kites: The Science and the Wonder*. Japan Publications, Inc., Tokyo, 1983.

Jue, David. *Chinese Kites*. Tuttle, Rutland, 1967.

Pelham, David. *Kites*. Penguin, Harmondsworth, 1976.

Schmidt, Norman. *Discover Aerodynamics With Paper Airplanes*. Peguis, Winnipeg, 1991.

Streeter, Tal. *The Art of Japanese Kites*. Weather Hill, New York, 1974.

Wagenvoord, James. *Flying Kites*. Collier, New York, 1969.

Yolen, Will. *The Complete Book of Kites and Kite Flying*. Simon and Schuster, New York, 1976.

CRAFTS

No, it's not r
cats and dogs b
sky is filled with an
Look up and you ma
dragonfly darting it
through the clouds, falcons soaring along the horizon, multi-c
peacocks, or a zebra hundreds of feet in the air. Yes, a zebra! Of c
they're actually kites. Now, you too can learn how to make thes
kites. Every design is different, which means that every one wil
its own flight pattern! Some will fly above the clouds, while othe
and zoom low to the ground. And all the basic guidance and in
tion necessary to build 19 different designs is included. Next
someone tells you to go fly a kite, you can say, "Which one!"

Sterling Publishing Co., Inc.
New York
A STERLING/TAMOS BOOK

ISBN 1-895569-36-2

EAN 9 781895 569360 90000>

£12.99P

UPC 7